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PREFACE

1. Scope

This publication provides guidelines for planning and conducting joint space operations. It provides space doctrine fundamentals for all warfighters — air, land, sea, space, and special operations forces; describes the military operational principles associated with support from and through space, and operating in space; explains US Space Command relationships and responsibilities; and establishes a framework for the employment of space forces and space capabilities.

2. Purpose

This publication has been prepared under the direction of the Chairman of the Joint Chiefs of Staff. It sets forth doctrine to govern the joint activities and performance of the Armed Forces of the United States in joint operations and provides the doctrinal basis for US military involvement in multinational and interagency operations. It provides military guidance for the exercise of authority by combatant commanders and other joint force commanders (JFCs) and prescribes doctrine for joint operations and training. It provides military guidance for use by the Armed Forces in preparing their appropriate plans. It is not the intent of this publication to restrict the authority of the JFC from organizing the force and executing the mission in a manner the JFC deems most appropriate to ensure unity of effort in the accomplishment of the overall mission.

3. Application

a. Doctrine and guidance established in this publication apply to the commanders of combatant commands, subunified commands, joint task forces, and subordinate components of these commands. These principles and guidance also may apply when significant forces of one Service are attached to forces of another Service or when significant forces of one Service support forces of another Service.

b. The guidance in this publication is authoritative; as such, this doctrine will be followed except when, in the judgment of the commander, exceptional circumstances dictate otherwise. If conflicts arise between the contents of this publication and the contents of Service publications, this publication will take precedence for the activities of joint forces unless the Chairman of the Joint Chiefs of Staff, normally in coordination with the other members of the Joint Chiefs of Staff, has provided more current and specific guidance. Commanders of forces operating as part of a multinational (alliance or coalition) military command should follow multinational doctrine and procedures ratified by the United States. For doctrine and procedures not ratified by the United States, commanders should evaluate and follow the multinational command's doctrine and procedures, where applicable and consistent with US law, regulations, and doctrine.

For the Chairman of the Joint Chiefs of Staff:



JOHN P. ABIZAID
Lieutenant General, USA
Director, Joint Staff

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EXECUTIVE SUMMARY

COMMANDER'S OVERVIEW

- Describes a Foundation for Military Space Operations
 - Describes Space Organizations and Missions
 - Describes Command and Control of Space Forces
 - Outlines Military Space Operations Mission Areas
 - Outlines Support to Space Planning
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A Foundation for Military Space Operations

Technological advances in space systems have increased the importance of space power to the warfighter and US national interests.

The use of space capabilities by the US military has changed significantly since the first military satellites were orbited. Continuous improvements in space technology have led to the development of more advanced space systems. Space capabilities have proven to be a **significant force multiplier** when integrated into joint operations. Military, civil, and commercial sectors of the United States are **increasingly dependent** on space capabilities, and this dependence can be viewed by adversaries as a **potential vulnerability**.

Space superiority ensures US and allied forces have the freedom to take advantage of the capabilities provided by space systems.

The United States must be able to protect its space assets (and when practical and appropriate, those of its allies) and deny the use of space assets by its adversaries. **Commanders** must **anticipate hostile actions** that attempt to deny friendly forces access to or use of space capabilities. They should also anticipate the **proliferation** and increasing sophistication of **space capabilities** and products with military utility that could be used by an adversary for hostile purposes. Potential adversaries no longer have to develop the infrastructure necessary to obtain **space capabilities**; today, the necessary capabilities may be purchased.

Space has several unique characteristics that differentiate it from the air, land, and sea. Accepted international conventions do not extend a nation's geographical boundaries into Earth orbit. Therefore, nations enjoy unimpeded satellite overflight of other nations through space. Spacecraft movement is not significantly impeded by any of the Earth's surface features (such as terrain), but instead is primarily governed by orbital mechanics, thereby allowing satellites to remain in orbit for extended periods of time (i.e., years). The space environment affects the performance of both terrestrial and space systems. Commanders need to be aware of these characteristics (and the resulting operational impacts) to understand the capabilities and limitations of space forces while in support of joint operations. The special characteristics of space and the difficulty in gaining access to it present unique planning and operational considerations that affect both friendly, adversary, and neutral space forces alike. The joint space planner must not only understand planning and operational considerations for employment of space capabilities, but must also have a firm knowledge of the threats to the use of those systems by an adversary and understand what can be done to limit an adversary's use of space capabilities while protecting friendly uses of space.

Space Organizations and Missions

The Services integrate space capabilities into all facets of their activities.

The Services, in accordance with Department of Defense (DOD) Directives, shall integrate space capabilities and applications into all facets of their strategy, doctrine, education, training, exercises, and operations of US military forces. The Chairman of the Joint Chiefs of Staff (CJCS) is responsible for establishing a uniform system for evaluating readiness of each combatant command and combat support agency to carry out assigned missions by employing space forces, developing joint doctrine, education, and training for the operation and employment of space systems of the Armed Forces, integrating space forces and their supporting industrial base into the Joint Strategic Capabilities Plan, formulating policies for the integration of National Guard and Reserve forces into joint space activities, and providing guidance to combatant commanders for planning and employment of space capabilities through the joint planning process.

The Commander, United States Space Command ensures the most effective use of space assets.

The Commander, United States Space Command (USSPACECOM) integrates and synchronizes DOD space capabilities to ensure the most effective use of these resources. USSPACECOM must be able to quickly plan, direct, coordinate, and control space assets and forces for daily operations, for crisis action planning, and in the event of war against the United States and/or its allies. Furthermore, USSPACECOM must continuously support US North American Aerospace Defense Command (NORAD) in supporting US and Canadian national leaders by providing warning of aerospace attacks against North America. In addition, USSPACECOM provides warning to US national leaders of attacks against US space assets worldwide. USSPACECOM executes these warning responsibilities through the Cheyenne Mountain Operations Center (CMOC); and US Element CMOC.

USSPACECOM operates assigned space forces through its Service component commands — **Army Space Command**, **Naval Space Command**, and **Space Air Forces**. These components have distinct space missions.

Task organized joint space support teams provide support to combatant commands to assist in integrating space capabilities.

USSPACECOM uses space support teams to assist combatant commands. Upon request from a combatant commander, subordinate joint force commander (JFC), or USSPACECOM theater space liaison officer (LNO), USSPACECOM will deploy task-organized **joint space support teams** (SSTs) to the theater to supplement the supported commander's staff to assist in integrating space into the joint campaign plan and provide tailored space support through space support team personnel to train and/or assist Service forces. Each geographic combatant commander has a network of space operators resident on staffs at multiple echelons. Their primary purpose is to serve as weapons and tactics advisors for space systems (national, civil, commercial, military, and foreign) and for integrating space capabilities into joint force planning and employment. USSPACECOM **LNOs** may be attached to supported combatant commander staffs to help ensure that space-based capabilities are appropriately integrated into respective combatant commander's planning, operations, training, and execution. Commander, USSPACECOM may also direct space component commanders to provide tailored space support through SSTs that are task-organized and equipped to meet the needs of the supported commander.

The Joint SST and Service space component command's SSTs and/or deployed space support personnel coordinate the support provided to a particular theater among themselves and other national agencies' theater support teams. Several DOD and national agencies deploy theater support teams whose capabilities and/or products can enhance or complement space force support. These include a national intelligence support team made up from Defense Intelligence Agency, National Security Agency, Central

Intelligence Agency, National Imagery and Mapping Agency, other intelligence community agencies as required, as well as the National Reconnaissance Office's Operational Support Office team.

Command and Control of Space Forces

A supported joint force commander (JFC) normally designates a single authority to coordinate joint theater space operations and integrate space capabilities. Based on the complexity and scope of operations, the JFC can either retain authority or designate a component commander to coordinate and integrate space operations. The JFC considers the mission, nature and duration of the operation, preponderance of space force capabilities, and the command and control capabilities (including reach-back) in selecting the appropriate option.

The supported commander must ensure the integration of space capabilities into the campaign.

Space forces are an integral part of military operations and, consistent with the Commander, USSPACECOM guidance, are directed to meet the requirements of supported commanders. During mission execution, the Commander, USSPACECOM will retain combatant command (command authority) of assigned space forces. In most cases, space capabilities are available to supported commanders but are not deployed to the joint operations area. Where appropriate, the Commander, USSPACECOM may transfer forces with Secretary of Defense approval to the supported combatant commander, subordinate JFC, and/or subordinate commander depending upon the nature of the operation and the specific space capability to be employed.

Commander, USSPACECOM will plan and organize day-to-day operations and publish mission-type orders for future execution by components. To facilitate unity of the theater/joint operations area (JOA) space effort, the supported combatant commander or a joint force commander (JFC) may designate a space authority. The space authority will coordinate space operations, integrate space capabilities, and have primary responsibility for in-theater joint space operations planning. The coordinating authority typically will be the joint force air component commander, joint force land component commander, or joint force maritime component commander. In this position, the space authority designated by the JFC will coordinate space support of established objectives and act on behalf of the combatant commander with primary responsibility in theater for joint space operations planning.

Each combatant commander staff includes personnel who are trained to access and use products of space-based capabilities (ISR, satellite communications, etc.) to support combatant commander mission requirements.

Military Space Operations

Military space operations are an integral part of joint operations.

The importance of space operations is increasing due to the enabling capabilities they provide the warfighter. Space capabilities are vital to overall military mission accomplishment, provide the advantages needed for success in all joint operations, and support the principles of war.

Within the domain of space operations, there are four primary mission areas: **space control, force enhancement, space support, and force application.**

Space control ensures freedom of action in space for the United States and its allies and, when directed, denies an adversary freedom of action in space.

Space force enhancement operations improve joint force effectiveness as well as support other intelligence, civil, and commercial users.

Space support operations are combat support service operations.

Space force application operations are combat operations in, through, and from space to influence the course and outcome of conflict.

Space control operations provide freedom of action in space for friendly forces while, when directed, denying it to an adversary, and include the broad aspect of protection of US and US allied space systems and negation of enemy adversary space systems. Space control operations encompass all elements of the space defense mission and include offensive and defensive operations by friendly forces to gain and maintain space superiority and situational awareness if events impact space operations.

Space force enhancement operations multiply joint force effectiveness by enhancing battlespace awareness and providing needed warfighter support. There are five force enhancement functions: **intelligence, surveillance, and reconnaissance; integrated tactical warning and attack assessment; environmental monitoring; communications; and position, velocity, time, and navigation.**

Space support operations consist of operations that launch, deploy, augment, maintain, sustain, replenish, deorbit, and recover space forces, including the command and control network configuration for space operations. Support operations consist of spacelift, satellite operations, and deorbiting and recovering space vehicles, if required.

Space force application operations consist of attacks against terrestrial-based targets carried out by military weapons systems operating in or through space. **Currently, there are no space force application assets operating in space.**

Space Planning

Deliberate Planning

Commanders must address space force use during deliberate planning to effectively synchronize and integrate space forces within the theater, to counter an adversary's use of space, to maximize use of limited space assets, and consolidate theater operational requirements for support from space. Coordination of space operations between the staffs of the supported and supporting commanders is normally established through the designation of a space authority by the combatant commander and/or subordinate JFC. The designated space authority will ensure the identification of operational requirements and their inclusion in the appropriate annex. The result of this process is a supportable, valid statement of requirements that can be used by the supporting commander to prepare supporting joint operation plans (OPLANs). Commander, USSPACECOM, in coordination with the Chairman of the Joint Chiefs of Staff, must make quick decisions and have the capability to plan, direct, coordinate, and control space assets and forces in response to tasking by the Secretary of Defense or emergency situations that affect space assets and missions. Regardless of whether the Commander, USSPACECOM is the supported or the supporting commander, Commander, USSPACECOM develops an operation order (OPORD) to conduct operations. Primary responsibility for the OPORD rests with the supported commander, who may use off-the-shelf joint planning documents, such as OPLANs, as the basis for crisis action planning.

Crisis Action Planning

CONCLUSION

The ability to rapidly project and sustain US military capability worldwide is a basic requirement for the Armed Forces of the United States. The US military continuously deploys space assets and space forces, enhancing force projection and military operations. This publication establishes a framework for the use of space capabilities and the integration of space operations into joint campaigns and operations.

CHAPTER I

A FOUNDATION FOR MILITARY SPACE OPERATIONS

“There is in every battlefield a decisive point the possession of which, more than any other, helps to secure victory by enabling its holder to make a proper application of the principles of war.”

Lieutenant General Antoine-Henri, Baron de Jomini, 1838

SECTION A. MILITARY SPACE OVERVIEW

1. Military Space Operations Overview

a. The use of space capabilities has proven to be a **significant force multiplier** when integrated into joint operations. To ensure effective integration, joint force commanders (JFCs) and space operators must have a **common and clear understanding** of how space forces and space capabilities contribute to joint operations, and how military space operations should be integrated with other military operations to achieve US national security objectives.

b. The **use of space capabilities** by the US military has changed significantly since the first military satellites were orbited. Continuous improvements in space technology have led to the development of more advanced space systems. This change has led to a need for commanders to view space capabilities in a new light.

- Military, civil, and commercial sectors of the United States are **increasingly dependent** on space capabilities, and this dependence can be viewed by adversaries as a **potential vulnerability**. Accordingly, it is now US Government (USG) policy that purposeful interference with US space systems will be viewed as an infringement on the Nation’s sovereign rights.
- Space capabilities are based on complex systems that include the following: ground stations; launch facilities; satellite production, checkout, and storage facilities; communications links; user terminals; and spacecraft (both manned and unmanned). US space capabilities, especially ground assets and supporting infrastructure, are potential targets for adversaries with the means to attack them. US dependence on space capabilities increases the likelihood that potential adversaries will threaten US space assets. The United States must be able to protect its space assets (and when practical and appropriate, those of its allies) and deny the use of space assets by its adversaries.
- **Commanders** must **anticipate hostile actions** that attempt to deny friendly forces access to or use of space capabilities. They should also anticipate the **proliferation** and increasing sophistication of **space capabilities** and products with military utility that could be used by an adversary for hostile purposes. Potential adversaries no longer have to develop the infrastructure necessary to obtain **space capabilities**; today many of these capabilities can be purchased. Options available to prevent an adversary access to space capabilities include diplomatic, legal, economic, and military measures.
- Space superiority ensures US and allied forces have the freedom to take advantage of the capabilities provided by space systems.
- Given the increased US military and commercial dependence on space, it is imperative for the US to view space and space capabilities in an integrated fashion. The warfighter needs to recognize that space capabilities, once integrated into the total warfighting effort, are a significant force multiplier. To achieve optimal support from space, all space capabilities and systems (military, national, civil, commercial, and multinational), as well as the means to protect those capabilities, must be integrated into military planning.
- Commanders should use space-based systems to achieve access in support of operations worldwide. Space-based systems are unique in that they are already deployed and can be in place (in theory) when crises arise. Information from space systems is available to deploying units continuously.

c. US space systems provide unique capabilities and offer global force enhancements that are critical to prevailing in today's and tomorrow's conflicts. To realize the global advantages provided by space forces, JFCs must **understand** the applications of space capabilities, have **access** to space-based support sufficient to accomplish their missions, use space systems to the degree needed for completing required tasks expeditiously, and make recommendations to **deny or limit an adversary's** access to space and use of space systems.

d. This doctrine will aid the exploitation of US space power by supporting the **integrated employment** of space capabilities in joint operations. It establishes a framework for the integration of space operations into joint campaigns, major operations, battles, and engagements. **Experience** gained in the conduct of military space activities in support of military operations has **influenced the development** of this joint doctrine. The lessons learned from these activities have emphasized the importance of the contributions of space support of mission planning through mission execution and have been the basis of this doctrine development.

SECTION B. OPERATIONAL CONSIDERATIONS FOR SPACE

2. Characteristics of Space

Space has several unique characteristics that differentiate it from the air, land, and sea. Commanders need to be aware of these characteristics (and the resulting operational impacts) to understand the capabilities and limitations of space forces while in support of joint operations.

a. **No Geographical Boundaries.** Accepted international conventions do not extend a nation's geographical boundaries into Earth orbit. Therefore, nations enjoy unimpeded satellite overflight of other nations through space. Operating from space provides line of sight (LOS) access to large areas (including remote and denied access areas), which offers advantages for communications, navigation, meteorology and oceanography, and intelligence, surveillance and reconnaissance (ISR).

b. **Motion not Affected by the Earth's Surface.** Spacecraft movement is not significantly impeded by any of the Earth's surface features (such as terrain), but instead is primarily governed by orbital mechanics. **Satellites in space move at high velocity with minor retarding forces**, thereby allowing them to remain in orbit for extended periods of time (i.e., years).

c. **Unique Characteristics.** As with land, sea and air, space has unique physical characteristics. The **space environment affects both terrestrial and space systems**. The space environment affects the performance of military, commercial, and civil systems in space, air, land and sea (e.g., radar, communications, ISR systems). Solar flares and other natural phenomena in space create storms and atmospheric changes that can interrupt communications, cause electronic failures, and reduce performance of sensors and communications.

3. Considerations for Joint Space Planners

The special characteristics of space and the difficulty in gaining access to it present unique planning and operational considerations that affect friendly, adversary, and neutral space forces alike. There are presently numerous resource and legal considerations that must be weighed during planning stages in order to ensure mission success. The joint space planner must not only understand planning and operational considerations for employment of space capabilities, but must also have a firm knowledge of the threats to the use of those systems by an adversary. The joint space planner must understand what can be done to limit an adversary's use of space capabilities and how to protect our own use of space.

"Space is a realm in which many military operations are conducted more efficiently than by terrestrial systems. Military satellites have been operating in space for more than twenty years, and our accomplishments in DESERT STORM emphasize that space has unquestionably evolved as a military theater of operations."

**Gen Charles A. Horner, Commander, US Space Command
(and Commander of Central Command Air Forces during DESERT SHIELD/STORM),
Testimony before the Senate Armed Services Committee, 22 Apr 93**

a. **Global Access.** The fact that there are no geographical boundaries and no terrestrial obstructions or limitations in space gives military forces **global access** and **extensive advantage**. Space is the ultimate high ground.

- A single satellite in a low-Earth polar orbit can overfly any location on the Earth's surface within a 24-hour period. However, basic **orbital mechanics** limit the time most satellites can remain over a particular geographic area. Except for a small number of orbits, the amount of time that a terrestrial user will be within a satellite's direct field of view will vary from minutes to days depending on the satellite orbit type and the field of view of the satellite sensor/antenna (see Appendix F, "Orbital Characteristics").
- With a sufficient number of satellites in a properly configured constellation, it is possible to maintain continuous LOS of, and have access to, any or all points on the surface of the Earth.
- Global access is one of the key advantages that space forces offer. Most spacecraft can serve multiple combatant commanders and/or users around the world simultaneously (e.g., missile warning satellites).

b. **Persistence.** The movement of on-orbit space assets is neither tied to the Earth's surface nor significantly impeded by the low-level atmosphere. This allows these assets to remain on orbit for extended periods of time (generally measured in terms of years). It should be noted, however, that except for certain geosynchronous satellites, orbital mechanics prevent satellites from providing continuous support to a given terrestrial area of interest (AOI). Because orbits are easily determined, short dwell times and intermittent coverage by a given satellite may provide to an adversary significant windows of opportunity for unobserved activity. Therefore, most satellite surveillance systems must be supplemented by other sensors if continuous surveillance of an area is desired.

c. **Limitations** on the operating lifetime of a satellite include the following.

- The design life of the satellite.
- Maintenance cannot currently be performed on most satellites. Repairs are limited to commanding the use of back-up systems.
- The amount of **fuel** carried for changing or maintaining the spacecraft's desired orbit and attitude (in particular for low orbits as they will eventually decay into the atmosphere without additional energy input).
- The type of orbit used by the spacecraft (see Appendix F, "Orbital Characteristics," for a discussion on orbits).

Satellite orbital maneuvers are costly in terms of fuel expended and generally require a great deal of time to perform. Satellite maneuvers shorten the overall useful life of the satellite.

d. **Predictable Orbits.** Once in orbit, many forces affect a satellite's motion. A satellite's motion or orbital location is predictable. This predictability allows for both warning of satellite overflight and maintaining situational awareness and tracking the location of objects in space. However, there are several forces at work that slowly degrade the prediction accuracy of a satellite's location. These forces will cause a satellite's orbit to slowly change. The magnitude of the effects (as a whole) cannot be precisely known but is predictable to a high degree of accuracy. A satellite may use propulsive forces to maneuver and change its orbit, making the orbit hard to predict to anyone but the organization initiating the maneuver. However, maneuvering is done at a high cost in terms of onboard fuel, a limited resource.

e. **Space capabilities may be vulnerable to attack.** Ground to satellite links is susceptible to jamming. Fixed command and control facilities are subject to attack, which could degrade the utility of a satellite's service over time. Launch facilities must be protected to ensure access to space so that force replenishment may be accomplished. Some space capabilities may also be subject to exploitation, such as an adversary using commercial global positioning system (GPS) receivers for navigation. Knowledge of an adversary's negation and exploitation capabilities will allow a joint space planner to develop appropriate responses.

f. **Resource Considerations.** Long lead times to replenish/replace space assets may force a commander to use only what assets are available at that moment.

- Current launch programs take 40-150 days to generate and launch, providing all hardware, including payload, is available at the launch site. Payload availability, pre-launch processing, positioning and on-orbit checkout are factors that can significantly lengthen the time from call-up to operating on-orbit.
- Some forces can perform multiple missions. For example some missile warning sites perform a secondary mission of space surveillance.
- Space systems are often assets requiring careful allocation. Although it may appear there are numerous satellites available to support every mission, these resources are limited. Therefore requirements are prioritized, and a commander may not receive the unlimited support desired. (For example, when communication across satellites is restricted due to limited capacity.)
- Users may be preempted based on priority. Competition for bandwidth, priorities for tasking, and similar constraints, combined with satellite physical access to specific locations, impact availability of space support.

g. **Legal Considerations.** Numerous domestic and international laws and treaties exist that must be considered in the planning stages of any mission anticipating space support. Legal advisors must be immediately available during all stages of planning and execution of space operations in order to ensure compliance with international law and US law and policy. Although some acts are prohibited, there are relatively few legal restrictions on the use of space for military purposes. Many of the restrictions may be applicable during space negotiation operations.

- International laws, including contracts and consortium agreements, prohibit certain space assets from being used for military purposes. For example, certain corporation agreements prohibit using satellite communications for military operations.
- International law, as it pertains to the use of force, regulation of the means and methods of warfighting, and protection of noncombatants, must be considered when conducting space control and space force application operations.

•• **Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, 1967.** The Outer Space Treaty provides that international law (under Article 51 of the United States Charter involving national self-defense) applies to space. Space is not subject to national appropriation; its activities are subject to international law; it is to be used for peaceful purposes with due regard for all; nations may not station or orbit in space or on celestial bodies (including the moon) any objects carrying nuclear weapons or any other weapons of mass destruction; and the stationing of troops or creation of military installations on the moon and other celestial bodies is prohibited.

•• **Anti-Ballistic Missile Treaty, 1972.** Prohibits development, testing, or deployment of space-based anti-ballistic missile systems or components. However, the treaty does not prohibit modeling and simulation of space assets and capabilities for analysis and experiment purposes.

•• **United Nations Convention on Prohibition of Military or Any Hostile Use of Environmental Modification Techniques, 1977.** Prohibits military or other hostile use of environmental modification techniques as a means of destruction, damage, or injury to the environment (including outer space) if such use has widespread, long-lasting, or severe effects.

•• **Arms Control Treaties.** Various arms control treaties also prohibit “interference” with “national technical means” (such as reconnaissance satellites) used to verify treaty compliance.

•• **Frequency Spectrum Management.** The International Telecommunications Union (ITU) governs terrestrial and space use of the radio frequency spectrum as well as the assignment of orbital positions in the geosynchronous belt (see Appendix F, “Orbital Characteristics”). Individual countries or host nations (HNs) have sovereignty over frequency usage within their borders. Radio frequencies used by space systems must therefore be coordinated with the ITU and with the HNs, including the United States, wherein Armed Forces of the United States intend to operate.

CHAPTER II

SPACE ORGANIZATIONS AND MISSIONS

“The unrelenting progress of mankind causes continual change in the weapons; and with that must come a continual change in the manner of fighting.”

**RADM Alfred Thayer Mahan,
*The Influence of Sea Power Upon History, 1890***

1. General

a. In accordance with Department of Defense (DOD) Directive 3100.10, *Space Policy*, DOD Instruction 3100.14, *Space Force Enhancement*, and DOD Instruction 3100.15, *Space Control*, the Services shall integrate space capabilities and applications into all facets of their strategy, doctrine, education, training, exercises, and operations of US military forces. The Secretary of Defense has directed the implementation of DOD organizations and management changes in accordance with Secretary of Defense (SecDef) memorandum 18 Oct, 2001, SUBJ: National Security Space Management and Organization.

b. In 2001, the Congressionally-chartered Commission to Assess United States National Security Space Management and Organization published its report on the role space plays in national security. It concluded that US dependence on space must be recognized as a top national security priority and the US must develop the means to deter and defend against hostile acts in and from space.

SECTION A. DUTIES AND RESPONSIBILITIES

2. Duties and Responsibilities

a. The Chairman of the Joint Chiefs of Staff (CJCS) will:

- Establish a uniform system for evaluating readiness of each combatant command and combat support agency to carry out assigned missions by employing space forces;
- Develop joint doctrine for the operation and employment of space systems of the Armed Forces and formulate policies for the joint space training of the Armed Forces and for coordinating the space military education and training of the members of the Armed Forces;
- Integrate space forces and their supporting industrial base into the Joint Strategic Capabilities Plan mobilization annex and formulate policies for the integration of National Guard and Reserve forces into joint space activities; and
- Provide guidance to combatant commanders for planning and employment of space capabilities through the joint planning process.

b. The Commander, United States Space Command (USSPACECOM) will:

- Serve as the single point of contact for military space operational matters, except as otherwise directed by the Secretary of Defense;
- Conduct space operations, including support of strategic ballistic missile defense for the United States;
- Coordinate and conduct space campaign planning through the joint planning process in support of the national military strategy; and
- Advocate space and missile warning requirements of other combatant commanders.

c. The combatant commanders will:

- Consider space in the analysis of alternatives for satisfying mission needs as well as develop and articulate military requirements for space and space-related capabilities;
- Integrate space capabilities and applications into operation plans (OPLANs) and operation plans in concept format (CONPLANs) as well as plan for the employment of space capabilities within their area of responsibility (AOR);
- Provide input for evaluations of the preparedness of their combatant command to carry out assigned missions by employing space capabilities;
- Coordinate on Commander, USSPACECOM campaign plans and provide supporting plans as directed by the Chairman of the Joint Chiefs of Staff; and
- Plan for and provide force protection, in coordination with Commander, USSPACECOM, for space forces not assigned but operating in their AOR.

SECTION B. UNITED STATES SPACE COMMAND OPERATIONS

3. United States Space Command Operations

In coordination with the Chairman of the Joint Chiefs of Staff, United States Space Command (USSPACECOM) must be able to quickly plan, direct, coordinate, and control space assets and forces for daily operations, for crisis action planning, and in the event of war against the US and/or its allies. Furthermore, USSPACECOM must continuously support US North American Aerospace Defense Command (NORAD) in NORAD's role in supporting US and Canadian national leaders by providing warning of aerospace attacks against North America. In addition, USSPACECOM provides warning to US national leaders of attacks against US space assets worldwide. USSPACECOM executes these warning responsibilities through the Cheyenne Mountain Operations Center (CMOC); and US Element CMOC (USELEMC Moc).

a. **CMOC.** CMOC is one of four NORAD component commands. It is a subunified and combined command. CMOC's principal responsibility is execution of NORAD's aerospace warning mission for the defense of North America. This mission is performed in support of Command in Chief, US North American Aerospace Defense Command and US and Canadian national leaders in accordance with the integrated tactical warning and attack assessment (ITW/AA) process defined in CJCS Emergency Action Procedures (EAP) Volume VI.

b. **USELEMC Moc.** USELEMC Moc is a USSPACECOM subunified command with responsibility for execution of USSPACECOM's space warning mission for the defense of US space systems worldwide. This mission is performed in support of Commander, USSPACECOM and US national leaders in accordance with the ITW/AA process defined in CJCS EAP Volume VI.

c. **USSPACECOM Space Operations Center (SPOC).** The SPOC is the focal point with USSPACECOM for obtaining space support.

d. **Day-to-Day Operations.** The NORAD and USSPACECOM Combined Command Center (CCC) and Space Control Center crews are in place to monitor day-to-day events. When a space-related incident or contingency requiring enhanced space support occurs, the command director and the mission director in the CCC assess the situation and notify the National Military Command Center (NMCC) and the NORAD and USSPACECOM chains of command (including the NORAD Operation Center and SPOC), as necessary. As an example, strategic missile warning information is sent to the combatant commander, affected subordinate JFCs, and/or subordinate commanders from NORAD-USSPACECOM's CMOC, which is backed up by the SPOC. USSPACECOM will also operate and maintain global and regional satellite communications (SATCOM) support centers to integrate all SATCOM day-to-day planning functions in direct support to the combatant commands and other users.

e. **Crisis Action Response.** If a crisis escalates to the degree that use of normal staff support is inadequate, then one or more of the USSPACECOM battle staff's crisis action elements are activated. These higher-level elements provide a greater degree of control and authority to resolve the situation. Activation of the crisis action team or battle staff can provide 24-hour, full-staff



NORAD USSPACECOM Combined Command Center, Cheyenne Mountain Air Station, Colorado

support. This activation is implemented where rapid Commander, USSPACECOM consultations, decisions, or recommendations are required.

f. **USSPACECOM SPOC.** The SPOC is the focal point within USSPACECOM for obtaining space-based support.

g. **NORAD USSPACECOM Combined Intelligence Center (CIC).** The CIC is the focal point for providing space-specific intelligence support on foreign space operations, employment, and capabilities, to include space control capabilities. The CIC provides information on foreign space facilities, provides theater-specific tailored space intelligence, and develops and maintains the foreign space orders of battle for the Department of Defense.

SECTION C. SERVICE COMPONENT OPERATIONS

4. Army Service Component; Navy Service Component; Air Force Service Component

USSPACECOM operates assigned space forces through its Service component commands — Army Space Command (ARSPACE), Naval Space Command (NAVSPACECOM), and Space Air Forces (SPACEAF). **These components have distinct space missions.**

a. The mission of **ARSPACE** is to provide space control operations and space support to the joint force and Army component, coordinate and integrate Army resources in the execution of USSPACECOM plans and operations, provide theater missile warning through employment of joint tactical ground stations (JTAGSs), provide space support through the use of Army space support teams, and perform Defense Satellite Communications System payload and network control. Additionally, ARSPACE functions as the SATCOM system expert (SSE) for Wideband Gapfiller System super-high frequency (SHF) communications satellites and is the parent command for the regional satellite communications support centers servicing all combatant commands, their components, and the Defense agencies and other users. US Army Space and Missile Defense Command is the US Army major command that organizes, trains, equips, and provides forces to ARSPACE and plans for national missile defense.

b. The **NAVSPACECOM** mission is to ensure space-based support to naval warfighters. This mission is accomplished via four means: operations and operational support; providing space expertise and training; requirements advocacy; and fostering the advancement of space technologies.

- NAVSPACECOM operates the Naval Space Operations Center (NAVSPOC) to provide integrated support to naval and joint warfighters as well as other members of the space community. The primary goal of the NAVSPOC is to provide situational awareness by monitoring not only space activity, but fleet deployments to ensure that space-based support is optimized. The NAVSPOC is capable of pushing space-related intelligence and other data products to fleet and Fleet Marine Forces on a continuous basis. Additional support and products may be provided as requested. The NAVSPOC also serves as operational manager of ultra high frequency (UHF) communications systems, provides satellite sustainment, and coordinates commercial satellite communications support. NAVSPACECOM also operates other space-based communications, meteorological and oceanographic (METOC), and research and development (R&D) systems in support of naval needs. NAVSPACECOM also provides manpower and training support for the Army's JTAGS units.
- The NAVSPOC serves as the Alternate Space Control Center, providing command and control (C2) of the space surveillance network in support of USSPACECOM operations. Also operated from within the NAVSPOC is the Naval Space Surveillance Radar Fence, which detects and tracks objects in space.
- Space expertise and training efforts range from the development and sponsoring of space curriculum within the Naval Academy and Postgraduate School, and the sponsoring of space "chairs," to the deployment of naval space support teams during battle group and amphibious ready group predeployment workups.
- Requirements advocacy, ensuring the naval needs are addressed in the development of emerging space systems, is provided to ensure long-term support to naval forces. Similarly, technology support, to include the support of Navy Tactical Exploitation of National Capabilities (TENCAP) programs and demonstrations, exploitation of advance imagery capabilities and prototyping related products, and partnerships with the naval R&D community, is geared towards future readiness and support.

"DESERT STORM was the first large scale opportunity for our forces in the field to understand that space systems are vital to their success..."

Asst. Secretary of the Air Force Martin C. Faga: *Air Force Magazine*, (Aug 91)

c. The mission of **SPACEAF** is to operate space forces for ballistic missile warning, navigation, communications, spacelift and space control, and to provide satellite operations capabilities. The SPACEAF commander will provide, plan, and exercise operational control (OPCON) of assigned forces as a component of the USSPACECOM. The SPACEAF commander exercises OPCON of assigned United States Air Force (USAF) space forces through the SPACEAF Aerospace Operations Center (AOC). The SPACEAF AOC is a standing AOC to support global space operations. When used for reachback, the SPACEAF AOC is the interface for the theater to gain access to Air Force space capabilities. It has the ability to expand during contingency support using augmentation. Air Force Space Command, a USAF major command, organizes, trains and equips USAF space forces for USSPACECOM to perform space control, force application, force enhancement, and space support.

SECTION D. THEATER SPACE SUPPORT

5. Theater Space Support

Services assign space operators to unified and subunified commands, theater component staffs, major commands, USAF numbered air forces and wings, Army corps, Navy carrier battle group staffs, and Marine Corps expeditionary forces. USSPACECOM and Service component space support teams task-organize at the unified, subunified, joint task force (JTF), and component command levels to support operations at the operational and tactical levels. Upon request from a combatant commander, subordinate JFC, or USSPACECOM theater space liaison officer (LNO), USSPACECOM will deploy joint space support teams (JSSTs) to the theater to supplement the supported commander's staff to assist in integrating space into the joint campaign plan. In addition, Commander, USSPACECOM may direct space component commanders to provide tailored space support through space support teams (SSTs) personnel to train and/or assist Service forces in theater. JFCs should assign either the Service space experts or SSTs to the joint component commanders' staffs. In the case of the Air Force, space expertise is embedded in each theater staff. Space expertise from the other Services are found in their SSTs. JFCs and their components should request space support early in the planning process to ensure effective and efficient use of space assets.

6. Theater Space Expertise

Each geographic combatant commander has a network of space operators resident on staffs at multiple echelons. Their primary purpose is to serve as weapons and tactics advisors for space systems (national, civil, commercial, military, and foreign) and for integrating space capabilities into joint force planning and employment. These individuals concentrate primarily on working the detailed activities of theater space operations.

7. Space Liaison Officer

USSPACECOM LNOs may be attached to supported combatant commander staffs in order to help ensure that space-based capabilities are appropriately integrated into respective combatant commander's planning, operations, training, and execution. The coordination of routine/peacetime space support issues by USSPACECOM is conducted by the geographic combatant commander's space LNO. During crisis, and if deployed, this function is performed primarily through the JSST from USSPACECOM.

8. Joint Space Support Team

a. A JFC can request a JSST. On SecDef order, USSPACECOM transfers task-organized JSSTs to the OPCON of the supported combatant commander to facilitate tasking and use of joint space forces and ensure that space support is provided to the supported combatant commander. The USSPACECOM SPOC can be contacted telephonically and through the Global Command and Control System on a 24-hour basis with requests for JSST support. Response time will vary depending on the situation and extent of support requested. Once the JSST is transferred to a theater, the JSST will serve in accordance with existing plans. This should include support to the space authority.

b. Specific examples of tailored support provided by JSSTs to JFCs include the following.

- Facilitating the distribution of missile warning data and other space-based information to the theater.
- Forecasting the vulnerability of friendly operations to observation by non-US satellites.
- Assisting in composing appropriate portions of CONPLANs and OPLANs.
- Deconflicting of DOD space systems requirements between the component commanders.
- Providing information on foreign space reliance and methods to deny (or exploit) adversary utilization of space.
- Providing detailed information on US and foreign satellite capabilities and operational status and the threat posed by foreign space systems.
- Developing space event inputs for exercises.
- Advising the JFC of possible force enhancement options provided by available space systems.
- Coordinating in-theater space control assets.
- Ensuring that joint forces obtain the appropriate level of space weather support.
- Providing tailored training to combatant commander and/or subordinate JFC staff on space-related issues and systems.

9. Component Space Support Teams

a. In addition to JSST support, Commander, USSPACECOM may also direct space component commanders to provide tailored space support through SSTs. Both ARSPACE and NAVSPACECOM have SSTs that are task-organized and equipped to meet the needs of the supported commander. The USAF does not maintain SSTs but has integrated space support personnel into all Air Force component staffs. Once forces are transferred to the theater, all space support teams and personnel will provide support in accordance with theater space support plans.

b. Specific examples of tailored support provided by SSTs to Service components of JTFs, corps, and Marine Corps expeditionary forces include the following.

- Analysis of impact of space capabilities on courses of action (COAs).
- Space-related planning.
- Intelligence preparation of the battlespace (IPB) support.
- Mission rehearsal support.
- Imagery and rectified multi-spectral imagery (MSI) products.
- Exercise and training support.
- Predicted GPS navigation signal accuracy.
- Coordination of in-theater Service space control assets.
- Enemy and commercial space order of battle assessment.
- Orbit predictions to determine vulnerabilities of forces on the ground and availability of US, allied, and/or commercial satellites.
- Space-based information, products, and necessary reach-back.

10. Support From Other Space Systems and Organizations

Space assets are operated by many different organizations. All can provide capabilities that support a JFC.

National — National security space capabilities operated by DOD and the US Intelligence Community.

DOD — Defense support space capabilities operated by the Armed Services and USSPACECOM.

Civil — Space capabilities operated by USG departments and agencies other than DOD.

Commercial — Privately owned space capabilities operated as a business or to provide a service.

Foreign — Space capabilities operated by another nation or consortia not under the control of the USG.

a. The JSST and Service space component command's SSTs and/or deployed space support personnel coordinate the support provided to a particular theater among themselves and other national agencies' theater support teams. Several DOD and national agencies deploy theater support teams whose capabilities and/or products can enhance or complement space force support. These include a national intelligence support team (NIST) from Defense Intelligence Agency (DIA), National Security Agency, Central Intelligence Agency, National Imagery and Mapping Agency (NIMA), Central Measurement and Signature

Intelligence Office, or other intelligence community agencies as required. The National Reconnaissance Office (NRO) provides the combatant commands with an LNO and, if required, an Operational Support Office team as part of the NIST.

b. The Army and Air Force have additional space support capabilities and units that are not part of their respective space components. The Army has TENCAP program companies in each corps and platoons in each division that receive ISR and weather data from space platforms. These units may be tasked through their respective component to provide TENCAP systems such as the Army's Tactical Exploitation Systems and the Air Force tactical data processing suite in support of joint operations in a given theater and/or joint operations area (JOA).

c. Combatant commanders can supplement their space capabilities with systems operated by national, civil, and commercial agencies. The command staff element responsible for the specific function (communications, imagery, geospatial support, etc.) works through its channels to the correct defense agency (e.g., Defense Information Systems Agency [DISA] or DIA) or national agency (e.g., NIMA or NRO) to get the needed support or products. Another avenue is USSPACECOM. Although it does not operate space systems assigned to national agencies or owned by civilian corporations or international consortiums, USSPACECOM has established agreements and working relationships with the National Aeronautics and Space Administration, NRO, National Oceanic and Atmospheric Administration (NOAA), International Telecommunications Satellite Organization and International Maritime Satellite Corporation.

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CHAPTER III

COMMAND AND CONTROL OF SPACE FORCES

“Know the enemy and know yourself; in a hundred battles you will never be in peril.”

Sun Tzu, *The Art of War*
400-320 BC

Since space capabilities have global applications, space forces can potentially support military operations simultaneously in virtually any AOR. However, space systems and capabilities are not unlimited, and therefore must be prioritized, deconflicted, integrated, and synchronized across all joint operations.

1. Command Relationships

DOD space forces are an integral part of military operations. These forces are directed by USSPACECOM component commanders, consistent with Commander, USSPACECOM guidance to meet the requirements of the supported JFC, Commander, USSPACECOM, and the component commanders. During mission execution, Commander, USSPACECOM will normally retain OPCON of assigned military space forces through his component commanders. In most cases, space capabilities are available to the supported combatant commander, subordinate JFC, and/or subordinate commanders, but are not deployed to the JOA. At SecDef direction, Commander, USSPACECOM will transfer space forces or capabilities to the supported combatant commander, subordinate JFC, and/or subordinate commander, depending on the nature of the operation and the specific space capability to be employed. The appropriate command relationships (OPCON, tactical control [TACON], etc.) will then be established. As an example, Commander, USSPACECOM can deploy a JTAGS Detachment and transfer it (OPCON and/or TACON) to another combatant commander, subordinate JFC, and/or subordinate commander. Supported commanders requiring space forces and/or services must forward their requirements to the Chairman of the Joint Chiefs of Staff for approval by the Secretary of Defense.

2. Role of Non-Department of Defense Assets

a. The supporting commander can provide additional operational support by drawing on civil, commercial, national, and international space systems to augment military space capabilities. The use of non-US systems cannot be guaranteed, and may be used by the adversary as well.

b. **Nonmilitary capabilities** are used when they are the only means of providing the type of required support or when they provide similar capabilities at a reduced cost with no risk to national security. Generally, this takes place when **requests** from supported commands **outstrip available means**, to replace lost primary DOD capabilities, or when civil agencies such as NOAA are assigned to provide the services.

3. Space Command and Control Arrangements

a. **Global Command and Control.** Commander, USSPACECOM will plan and organize day-to-day operations and publish mission-type orders for future execution by components. Commander, USSPACECOM may designate a subordinate to manage space operations. Consistent with theater requirements and staff limitations, Commander, USSPACECOM should delegate as much operational level control as practical to the component commanders (see Figure III-1).

An example of the Commander, USSPACECOM serving as a supported combatant commander: Commander, USSPACECOM serves as the DOD Manager for Manned Space Flight Support Operations. Geographic supporting combatant commanders will provide planning for, supporting, and conducting the recovery of astronauts, space vehicles, and space payloads and objects within the commander's AOR as directed by the DOD Manager of Manned Space Flight Support.

b. **Theater Command and Control.** A supported JFC normally designates a single authority to coordinate joint theater space operations and integrate space capabilities. Based on the complexity and scope of operations, the JFC can either retain authority or designate a component commander to coordinate and integrate space operations. The JFC considers the mission, nature and

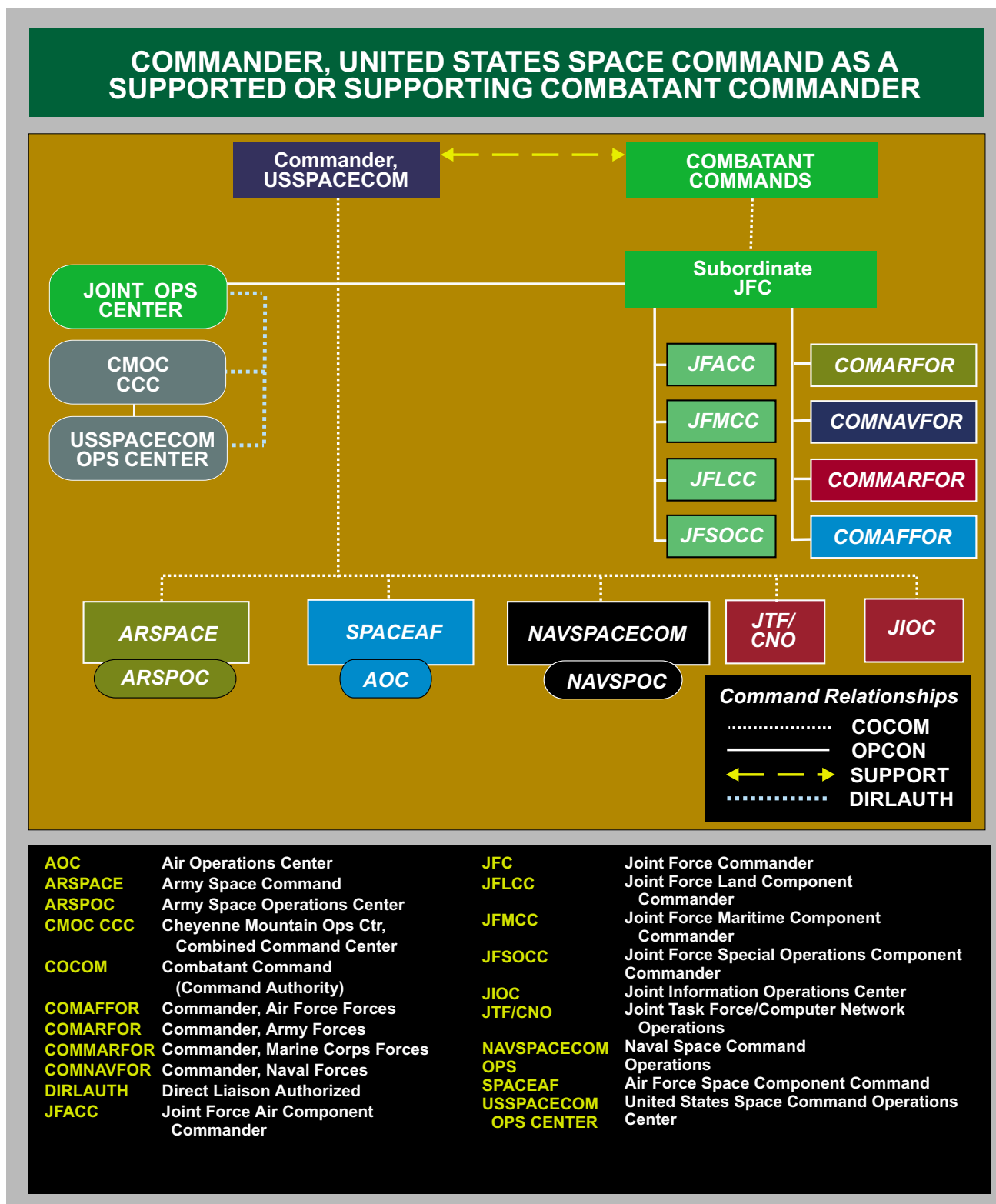


Figure III-1. Commander, United States Space Command as a Supported or Supporting Combatant Commander

duration of the operation, preponderance of space force capabilities, and the C2 capabilities (including reach-back) in selecting the appropriate option. The space authority will coordinate space operations, integrate space capabilities, and have primary responsibility for in-theater joint space operations planning. The space authority will normally be supported by a JSST and will coordinate with the component SSTs and/or embedded space operators. It gathers space requirements throughout the joint force. While the space authority may facilitate non-traditional uses of space assets, joint force staffs should utilize the established processes when planning traditional Space Force Enhancement missions — intelligence, surveillance and reconnaissance; integrated tactical warning and attack assessment; environmental monitoring; communications; and navigation and timing. Following coordination, the space authority provides to the JFC a prioritized list of recommended space requirements based on the joint force objectives. Upon JFC approval, the list is provided to Commander, USSPACECOM and the geographic combatant commander if applicable. To ensure prompt and timely support, Commander, USSPACECOM should authorize direct liaison between the space authority and Service components of USSPACECOM. This does not restrict joint force Service component commands from communicating requirements directly to their counterpart Service space component commander. However, the space authority and the Commander, USSPACECOM must be kept apprised of all such coordination activities to ensure that space activities are coordinated, deconflicted, integrated, and synchronized.

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CHAPTER IV

MILITARY SPACE OPERATIONS

“Doctrine consists first in a common way of objectively approaching the subject; second, in a common way of handling it.”

Marshal of France Ferdinand Foch, 1919

SECTION A. MILITARY SPACE OPERATIONS

1. Overview

a. **The principles of war and how space operations relate to each principle will be discussed in detail in this chapter, along with the operation and employment of space forces, which include the four primary space mission areas: space control, force enhancement, space support, and force application.**

b. Military space operations are an integral part of joint operations. **The importance of space operations is increasing** due to the enabling capabilities they provide the warfighter. Space capabilities are vital to overall military mission accomplishment and provide the advantages needed for success in all joint operations.

- The military capabilities provided by space forces should be **integrated and synchronized by the supported commander** into specific joint offensive and defensive operations, campaign planning, and into the concept of operations of their CONPLANs and/or OPLANs and operation orders (OPORDs).
- The supported and supporting commanders coordinate, as appropriate, the deployment and employment of space systems and personnel required to receive, process, and disseminate products provided by space forces. For example, space forces may provide missile warning information from space-based surveillance systems, but the supported commander must receive this information, integrate it with information from other warning and surveillance assets, and use the information in support of missile defense operations.

“The Gulf War highlighted areas where both USSPACECOM and supported combatant commanders implemented actions to ensure we take maximum advantage of our Nation’s military space systems. . . . Space forces were there when required . . . theater forces must acquire the equipment and develop the operational expertise necessary to receive, process, act on, and disseminate space data.”

**General Charles A. Horner:
Response to Questions from Senator Sam Nunn, 12 May 92**

- Each Service is responsible to develop and maintain a cadre of space expertise. These space operators will be assigned and integrated into theater staffs. This resident space expertise may be further augmented by the assignment of additional personnel (Joint, Army, Navy, Marine Corps, and Air Force) below the theater level to facilitate the use of space systems and provide additional support as required. Theater level space personnel plan, document, and lead theater space integration. Space expertise below the theater level will operate in accordance with theater space support plans.
- Space forces normally **support multiple users**, requiring extensive coordination and integration of requirements and capabilities. Support may involve multiple combatant commanders, national agencies, coalition partners, or nonmilitary users. For example, space-based navigation systems (e.g., GPS) not only support military users, but also support civil and commercial users, which may restrict the military’s ability to alter system accuracy to affect adversary users. Commander, USSPACECOM will deconflict, prioritize, and synchronize space capabilities in support of other combatant commanders and the Secretary of Defense. The establishing authority for a support relationship will determine solutions for the supported commander’s needs that cannot be fulfilled by the supporting commander.

SECTION B. PRINCIPLES OF WAR

2. General

Commanders must consider the following guidelines when planning and executing military operations and requesting space assets and/or capabilities.

a. **Understand how others use space systems** to support military and civilian operations (such as GPS use to support civil aviation).

b. Key in executing military space operations with our coalition partners is their access to information and our systems. In all cases, theater personnel must strive to provide the necessary and appropriate space-related information at the lowest appropriate security classification level. However, established procedures for disclosure of intelligence information (specifically information on US space systems and operations) must be followed in pursuing this goal.

c. Maintain an **awareness** of the supporting space forces and their operational status.

d. Understand how and why space capabilities are **integrated** into military operations.

e. Maintain space **situational awareness** and assess the potential impacts on space-based and ground-based systems and operations.

f. Space support operations, whether conducted by theater or space forces, must be **responsive** and, if possible, tailored to individual joint operations or campaigns.



Global Positioning System Satellite

3. Space and the Principles of War

The needs of the supported commander are the critical factors in conducting space operations. Space capabilities and their products enable the application of the principles of war.

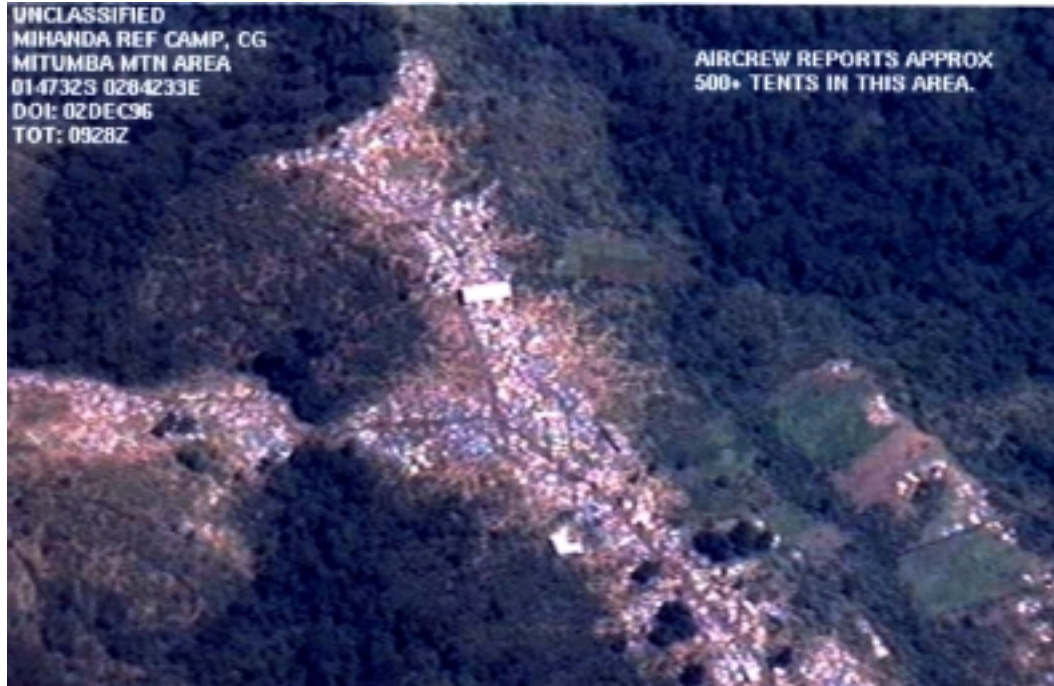
a. **Objective.** Direct every military operation toward a clearly defined, decisive, and attainable objective.

- Space forces and application of their capabilities are best employed when they contribute directly to achieving the commander's objectives.
- Commanders must understand the **capabilities and limitations** of space support operations to determine how to best support the joint force, which could include reprioritizing support activities.
- The appropriate joint headquarters must ensure that space objectives support the geographic combatant commander's objectives and are included for planning.

b. **Offensive.** Seize, retain, and exploit the initiative.

- A high priority for a commander should be to establish **space superiority** (just as air and sea superiority are also essential). The use of space control operations to support freedom of action in space will ensure the ability to provide space capabilities to the warfighter, and deny the opposing force the same.
 - **Global Coverage.** With the current on-orbit constellations of military satellites, US ability to rapidly employ forces is greatly enhanced. US forces can seize the initiative with in-place communication, navigation, environmental, ISR, and warning systems to exploit an adversary's weaknesses.
- c. **Mass.** Concentrate combat power at the place and time to achieve decisive results.
- It is critical for commanders to **integrate and synchronize supporting space forces**, so that the **concentration of combat power at the proper time and place can be most effective**. This conserves available resources, minimizes impact on non-adversaries, and maximizes the effect on the adversary.
 - **Precision navigation** capability enables the application of overwhelming force at key points of attack. For example, accurate navigation signals can improve weapon accuracy, thus increasing the probability of kill against fixed targets, minimizing collateral damage and allowing use of advanced stand-off munitions to increase crew survivability.
 - **Synchronization.** Space forces also provide a highly accurate time standard, permitting all units to synchronize their operations and allowing concentration of forces in time and space (geographically and positionally).
- d. **Economy of Force.** Allocate minimum essential combat power to secondary efforts.
- Space systems and space-based ISR assets can support attainment of **dominant battlespace awareness** to a commander. This reduces uncertainty and permits a reduction in the number and type of forces needed for secondary efforts. Space systems can detect an adversary's movement and support an immediate engagement before its actions can affect the friendly operation.
 - **Precision navigation** and smart munitions permit the engagement of targets with the minimum number of weapons needed to achieve the desired effect while minimizing collateral damage. This allows a commander to concentrate forces and apply the combat power at other points in the battlespace.
 - Other countries may be using the same space systems as an adversary. Identifying these third-parties and understanding their dependency on the use of space systems are necessary to aid decisionmaking in order to **minimize or avoid impact on others**. Agreements with space-faring nations and commercial and international organizations are essential in order to shape the international space community and ensure that potential adversaries are denied needed space capabilities in times of crisis and war.
 - Space combat operations may impact **friendly forces**. For example, the creation of space debris or jamming actions may impact friendly systems.
 - Due to the global nature of space systems and the fact that a satellite can be tasked to support several geographic combatant commanders each day, care must be taken to ensure that global and theater requirements are **balanced** and forces appropriately **allocated** to provide combat support based on identified military objectives. However, space forces will be deployed as needed based on requirements.
- e. **Maneuver.** Place the adversary in a position of disadvantage through the flexible application of combat power.
- **Navigation. ISR, weather, and communications support** provided by space forces allow units to perform precise, coordinated maneuvers with speed and confidence, even in featureless terrain or under limited visibility.
 - **Blue Force Tracking.** GPS and communications provided through space will enhance not only the maneuverability of blue forces but the C2 of these forces throughout the battlespace. Blue force tracking will provide a warfighter with enhanced situational awareness and potentially assist in reducing fratricide.

- Maneuvering a satellite could provide additional capabilities to a JFC and place the adversary at a disadvantage through prolonged observation. However, the decision to maneuver a satellite is multifaceted and currently requires **serious deliberation**. Maneuvering a satellite may change its ability to accomplish its current mission; but such a maneuver may be either necessary to optimize mission performance or be required by reprioritization of support to the warfighter. Maneuvers reduce the operational lifetime of the satellite by using its limited fuel. The exact nature of the maneuver is a balance between **expediency** (how quickly the maneuver must be completed) and **mission duration** (reduced by fuel expenditure).
- f. **Unity of Command.** Ensure unity of effort under one responsible commander for every objective.
- Commander, USSPACECOM is ultimately responsible for the conduct of US military space operations. When space forces are transferred to geographic combatant commanders, care must be given to ensure that space forces are commanded through a single chain of command.
 - **Coordination** is necessary when planning and executing space operations. The commander must optimize resources and ensure that actions do not interfere with each other or with the overall campaign plan. Supported JFCs normally designate a single authority to coordinate joint theater space operations and integrate space capabilities.
 - **Prioritize** all the space requirements for the AOR to ensure supporting command and supporting agencies have clear guidance on the supported combatant commander's intent.
 - Supporting space commanders must have a detailed **understanding** of the **supported commander's ability** to use information and data derived from space capabilities. Additionally, the supporting commander should provide the numbers and type of systems employed, system capabilities, and operational status.
 - The joint force should **integrate** space capabilities into its planning and operations and should consider the impact if the support is unavailable. To minimize confusion and the misapplication of assets, requests within a theater for space forces should be prioritized and processed applying a theater-wide perspective and by assessing how they satisfy the objectives.
 - Commander, USSPACECOM and component commanders must provide clear priorities and conflict resolution guidelines in support of contingency and normal operations. Given the changing nature of satellite operations, **supporting commanders must keep abreast of the current priorities and conflict resolution guidelines**. They should identify other users of the same space system and assess the impact of any modification to the use of the system. This information should then be used to adjudicate support conflicts.
 - The supported commander must be familiar with the process of requesting and receiving space support, and the **adjudication** process should there be conflicts between requirements.
 - Supporting commanders need **feedback** on how well the support requirements of terrestrial (air, land, sea, and special operations forces) commanders are being met. This will assist the supported commander in planning for follow-on support.
- g. **Security.** Never permit the adversary to acquire an unexpected advantage.
- The unique advantages of global coverage, wide fields of view, and the capability to revisit targets make observation of the Earth from space a powerful tool. Space forces can have access to any point on Earth, and proper management of satellite orbits and constellations offers overflight flexibility. This enhances the supported commander's ability to observe the AOI and increase battlespace awareness, **reducing the commander's uncertainty**.
 - **Know the adversary and understand the adversary's access to, use of, and dependency on space systems.** Since space technology is widely available through commercial sources, commanders must understand what technology is at an adversary's disposal and how well it may be used by US opponents. Commanders must also be familiar with the



Port Au Prince, Haiti: Computer generated perspective scene from LANDSAT 5 Thematic Mapper Imagery combined with Digital Terrain Elevation Data.

threat to US systems and be able to protect these systems by minimizing or eliminating the threat and implementing protection measures as appropriate.

- **Know the environment.** Observations and forecasts of the natural space and atmospheric environments are crucial to maintaining battlespace awareness and contribute directly to space superiority. This awareness allows friendly forces to mitigate weather impacts on US space and terrestrial systems and exploit impacts on adversary systems.

h. **Surprise.** Strike the adversary at a time or place or in a manner for which it is unprepared. Surprise is closely linked to security, since security measures are often needed to achieve the element of surprise. Space operations contribute to the element of surprise by providing timely intelligence, enhanced information sharing, and precision targeting, allowing the joint force to achieve success well out of proportion to the effort expended. Space control operations can foil the adversary's ability to determine US intentions through the use of space-based ISR, allowing us to maintain the element of surprise.

i. **Simplicity.** Prepare clear, uncomplicated chains of command, lines of coordination, plans, and concise orders to ensure thorough understanding. Every effort should be made to ensure that space operations are clearly understandable to everyone participating in the operational area.

SECTION C. SPACE MISSION AREAS

4. Space Control Mission Area

a. **General.** Space control operations provide freedom of action in space for friendly forces while, when directed, denying it to an adversary, and include the broad aspect of protection of US and US allied space systems and negation of adversary space systems. Space control operations encompass all elements of the space defense mission. Space control may involve activities conducted by land, sea, air, space and/or special operations forces. To gain space superiority, space forces must surveil space and terrestrial AOIs that could impact space activities, protect the ability to use space, prevent adversaries from exploiting US, allied, or neutral space services, and negate the ability of adversaries to exploit space capabilities. These forces would be brought to bear against space systems or facilities identified through the targeting process. Space control operations will provide freedom of action in space for friendly forces and, when directed, deny the same freedom to the adversary. They include offensive and

defensive operations by friendly forces to gain and maintain **space superiority** and **situational awareness** of events that impact space operations.

b. **Missions.** Space control operations include surveillance of space, protection, prevention, and negation functions (see Figure IV-1). These operations change in nature and intensity as the type of military operations changes. Prevention efforts can range from deterrence or diplomacy to military action. If prevention efforts fail, protection and negation functions may be performed to achieve space superiority. Negation focuses on denying an adversary's effective use of space. Prevention, protection, and negation efforts all rely on the ongoing surveillance of space and Earth to make informed decisions and to evaluate the effectiveness of their efforts. A space control matrix is shown in Figure IV-2.

- **Surveillance of Space.** Situational awareness is fundamental to the ability to conduct the space control mission. It requires: robust space surveillance for continual awareness of orbiting objects; real-time search and targeting-quality information; threat detection, identification, and location; predictive intelligence analysis of foreign space capability and intent in a geopolitical context; and a global reporting capability for friendly space systems. Space surveillance is conducted to detect, identify, assess, and track space objects and events to support space operations. Space surveillance is also critical to space support operations, such as placing satellites in orbit. Further, space situational awareness data can be used to support terrestrially-based operations, such as reconnaissance avoidance and missile defense.

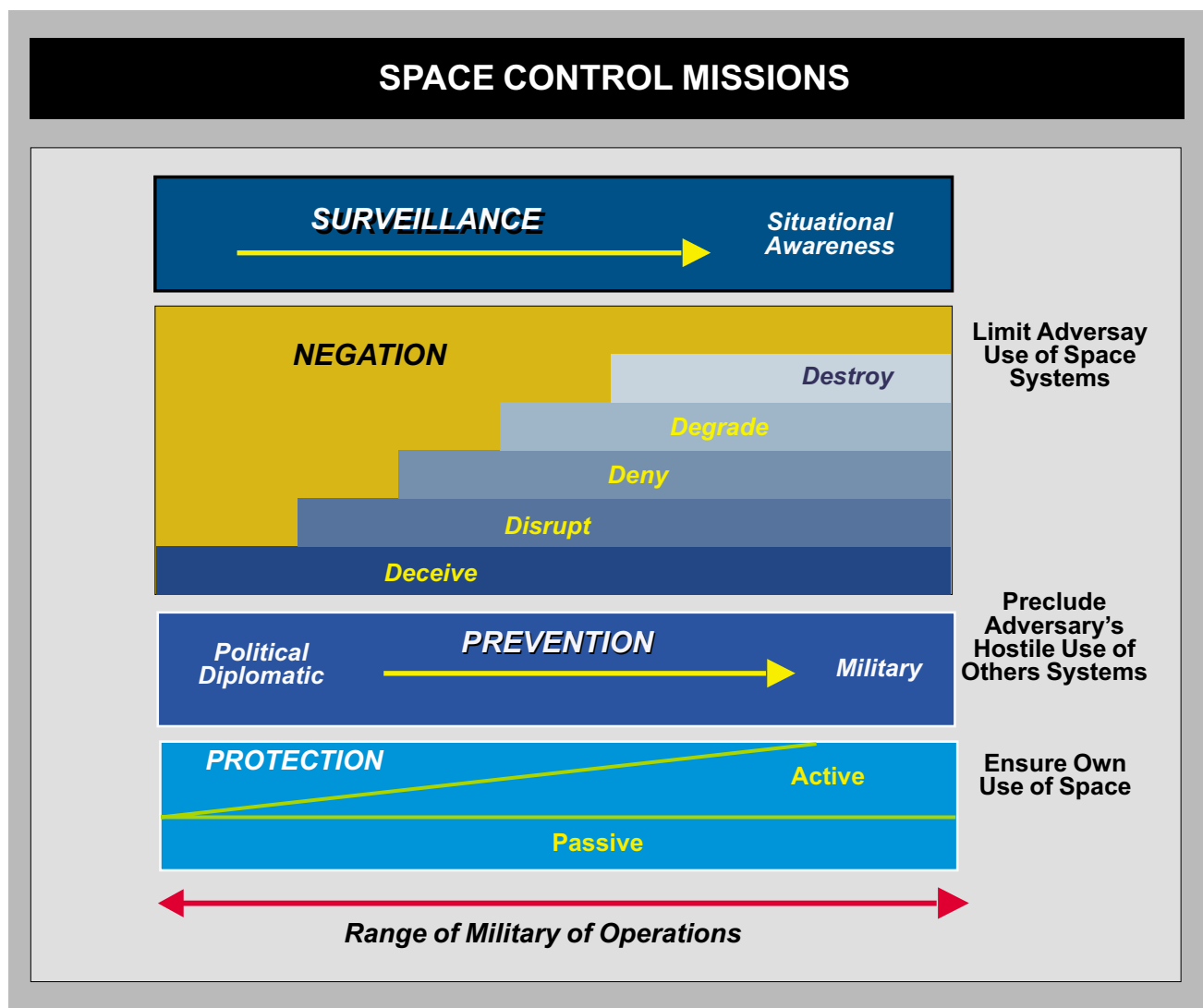


Figure IV-1. Space Control Missions

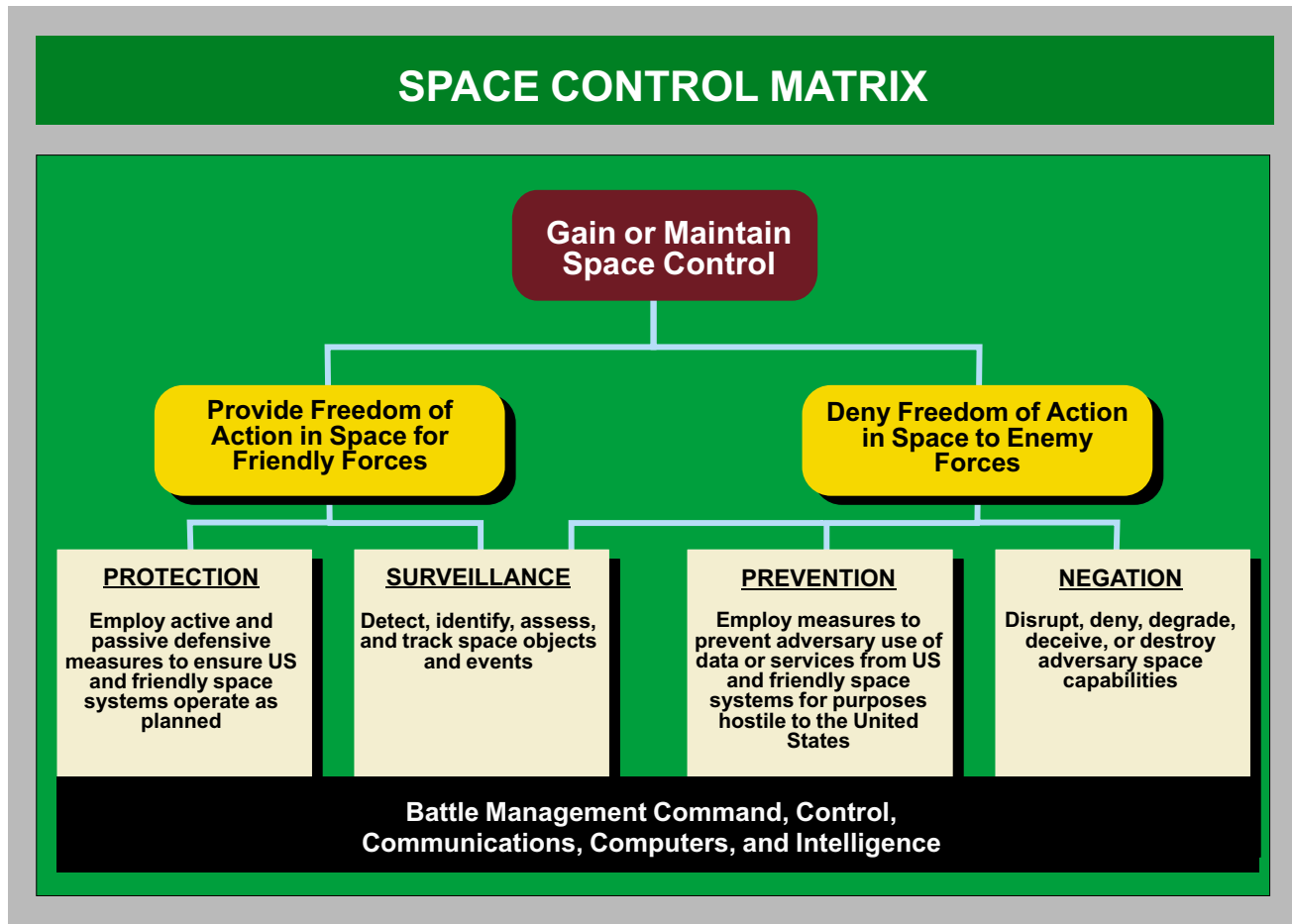


Figure IV-2. Space Control Matrix

- **Protection.** Active and passive defensive measures ensure that US and friendly space systems perform as designed by overcoming an adversary's attempts to negate friendly exploitation of space or **minimize adverse effects** if negation is attempted. Such measures also provide some protection from space environmental factors. Protection measures must be consistent with the criticality of the mission's contribution to the warfighter and are applied to each component of the space system, including launch, to ensure that no weak link exists. Means of protection include, but are not limited to, ground facility protection (security; covert facilities; camouflage, concealment, and deception; mobility), alternate nodes, spare satellites, link encryption, increased signal strength, adaptable waveforms, satellite radiation hardening and space debris protection measures. Furthermore, the system of protection measures should provide unambiguous indications of whether a satellite was under attack or in a severe space weather environment when any satellite anomaly or failure occurs. Finally, attack indications could be so subtle or dispersed that individually, an attack is not detectable. At a minimum, a common fusion point for possible indications from all USG satellites should be provided to allow centralized analysis.
- **Prevention.** Measures to preclude an adversary's hostile use of US or third party space systems and services. Prevention can include military, diplomatic, political, and economic measures as appropriate.
- **Negation.** Measures to **deceive, disrupt, deny, degrade, or destroy** an adversary's space capabilities. Negation can include action against the ground, link, or space segments of an adversary's space system.
 - **Deception.** Measures designed to **mislead the** adversary by manipulation, distortion, or falsification of evidence to induce the adversary to react in a manner prejudicial to their interests.

•• **Disruption. Temporary impairment** (diminished value or strength) of the utility of space systems, usually without physical damage to the space system. These operations include the delaying of critical, perishable operational data to an adversary.

•• **Denial. Temporary elimination** (total removal) of the utility of an adversary's space systems, usually without physical damage. This objective can be accomplished by such measures as interrupting electrical power to the space ground nodes or computer centers where data and information are processed and stored. For example, denying US adversaries position navigation information could significantly inhibit their operations.

•• **Degradation. Permanent partial or total impairment** of the utility of space systems, usually with physical damage. This option includes attacking the ground, control, or space segment of any targeted space system. All military options, including special operations, conventional warfare, and information warfare are available for use against space targets.

•• **Destruction. Permanent elimination** of the utility of space systems. This last option includes attack of critical ground nodes; destruction of uplink and downlink facilities, electrical power stations, and telecommunications facilities; and attacks against mobile space elements and on-orbit space assets.

5. Space Force Enhancement Mission Area

a. **General.** Force enhancement operations **multiply joint force effectiveness** by enhancing battlespace awareness and providing needed warfighter support. There are five force enhancement functions: ISR; integrated tactical warning and attack assessment; environmental monitoring; communications; and position, velocity, time, and navigation. They provide significant advantage by reducing confusion inherent in combat situations. They also improve the lethality of air, land, sea, space, and special operations forces. Force enhancement functions are also often provided by agencies such as NRO, NSA, NIMA, National Aeronautics and Space Administration, NOAA, commercial organizations, and consortiums. Appendices A through E discuss the space force enhancement functions in greater detail.

b. Missions

- **ISR.** Monitoring terrestrial (air, land, and sea) AOIs from space helps reveal location, disposition, and intention at the tactical, operational, and strategic levels of war. Such information provides warning of attack, operational combat assessment, tactical battle damage assessment (BDA), and feedback on how well US forces are affecting the adversary's understanding of the battlespace. ISR support is requested through established collection management channels within the intelligence community. Dissemination down to user warfighter level must be timely and assured.
- **Integrated Tactical Warning and Attack Assessment.** Satellite- and ground-based systems are crucial for providing timely detection and communicating warning of an adversary's use of ballistic missiles or nuclear detonations (NUDETs) to US strategic forces, tactically deployed forces, and US allies. ITW/AA is a composite term in satellite and missile surveillance. Tactical warning is a notification to operational command centers that a specific threat event is occurring. The component elements that describe threat events are: **Country of origin** — country or countries initiating hostilities; **Event type and size** — identification of the type of event and determination of the size or number of weapons; **Country under attack** — determined by observing trajectory of an object and predicting its impact point; and **Event time** — time the hostile event occurred. Attack assessment is an evaluation of information to determine the potential or actual nature and objectives of an attack for the purpose of providing information for timely decisions.
- **Environmental Monitoring.** Space forces provide data on meteorological, oceanographic, and space environmental factors that might affect operations in other battlespace dimensions. Additionally, space forces provide forecasts, alerts, and warnings of conditions in space. Imagery capabilities such as MSI can provide joint force planners with current information on surface conditions such as surface trafficability and beach conditions, vegetation, and land use. Knowledge of these factors allows forces to avoid adverse environmental conditions (such as poor surface conditions or severe weather), while taking advantage of other conditions to enhance operations. Such monitoring also supports IPB by providing the commander with information needed to identify and assess potential adversary COAs.



Satellite communications deployed to the field.

- **Communications.** Space-based communications offer many unique advantages that allow the JFC and subordinate commanders to shape the battlespace. Using military satellite communications and, in some cases, civil, commercial, and international systems, the JFC and subordinate commanders can execute reach-back operations, draw from planning support databases in the continental United States, sustain the two-way flow of data, and disseminate plans, orders, and force status over long distances, increasing C2 effectiveness, especially in areas with limited or no communications infrastructure. Satellite communications provide critical connectivity for maneuver forces whose rapid movement and non-linear deployments take them beyond inherent LOS communication networks.
- **Position, Velocity, Time, and Navigation.** Space forces provide precise, reliable position and timing information that permits joint forces to more effectively plan, train, coordinate, and execute operations. Space-based blue force tracking will improve C2 of assets and provide enhanced situational awareness while decreasing the chances of fratricide.
- The **NAVSTAR GPS** provides the primary space-based source for US and allied position, velocity, and timing requirements. Certain ground-based systems, primarily allied equipment, also utilize similar information from the Russian Glonass satellite constellation. This information enables precise location, velocity, and timing for such uses as navigation of terrestrial forces, combat identification, and target weaponeering for some precision munitions. Limitations: Like communications satellite uplinks and downlinks, GPS signal is also susceptible to hostile jamming and spoofing. Additionally, satellite information is only as accurate as the information uploaded to satellites. As such, errors in position, timing, and velocity can be induced into the downlinked information by uploading erroneous information to the satellite. Current satellite systems require continual monitoring and routine uploading of information in order to ensure accurate terrestrial position, velocity, and timing.

“The war with Iraq was the first conflict in history to make comprehensive use of space systems support. All of the following helped the Coalition’s air, ground, and naval forces: The DMSP [Defense Meteorological Support Program] weather satellites; US LANDSAT [land satellite] multi-spectral imagery satellites; the GPS; DSP early warning satellites; the tactical receive equipment and related applications satellite broadcast; the Tactical Information Broadcast Service; as well as communications satellites.”

DOD Report to Congress, *Conduct of the Persian Gulf War*, Apr 92

6. Space Support Mission Area

a. **General.** Space support operations consist of operations that launch, deploy, augment, maintain, sustain, replenish, deorbit, and recover space forces, including the C2 network configuration for space operations.

b. **Functions.** Support operations to space forces consist of **spacelift**, satellite operations (**telemetry, tracking and commanding (TT&C)**), and deorbiting and recovering space vehicles, if required.

- **Spacelift.** Spacelift is the ability to deliver satellites, payloads, and material into space. Spacelift operations are conducted to deploy, sustain, or augment satellite constellations supporting US military operations. During periods of increased tension or conflict, a spacelift objective is to launch and deploy new or replacement space assets and capabilities necessary to maintain, augment, or add to the operational capability of space systems to achieve national security objectives. This requires responsive, affordable launch capabilities.
- **Satellite Operations.** Satellite operations are conducted to maneuver, configure, and sustain on-orbit forces, and to activate on-orbit spares. Military satellite operations are executed through a host of dedicated and common-user networks. The Air Force operates the Air Force Satellite Control Network for common use satellite operations. The Naval Satellite Control Network provides satellite operations of communications, oceanographic and research satellites and packages in support of all joint warfighters. Several systems utilize dedicated antennas for both mission data retrieval and routine satellite TT&C. The various networks combined ensure total C2 of space resources.
- **Reconstitution of Space Forces.** Reconstitution refers to plans and operations for replenishing space forces in the event of loss of space assets. This could include repositioning and reconfiguring surviving assets, augmentation by civil and commercial capabilities and replacement of lost assets.



Delta II Launch Vehicle

7. Space Force Application Mission Area

The application of force would consist of attacks against terrestrial-based targets carried out by military weapons systems operating in or through space. The force application mission area includes ballistic missile defense and force projection. Currently, there are no force application assets operating in space.

CHAPTER V SPACE PLANNING

“Every unit that is not supported is a defeated unit.”

Field Marshal Maurice, Comte de Saxe, 1732

1. Deliberate Planning

a. Commanders must address space force use during deliberate planning to effectively integrate space forces within the theater, to counter an adversary’s use of space, to maximize use of limited space assets, and to consolidate theater operational requirements for support from space.

- Upon request, Commander, USSPACECOM (or a designated subordinate commander) may assist joint force planners in integrating space support considerations into plans for campaigns and major operations.
- Space planning must be embedded into the **current** deliberate planning process so that space forces and capabilities are appropriately integrated into each phase of the combatant commander’s campaign. The deliberate planning process consists of the five phases shown in Figure V-1.
- Specifically, space needs to be considered in the concept development, plan development, and supporting plans phases. Space should be properly incorporated into the basic plan and in many of the applicable annexes (e.g., B, C, J, K, N, and S, at minimum).
 - The concept development phase is further broken down into various steps. In mission analysis, space planners will assist the combatant commander in identifying assigned, implied, and subsidiary tasks for space forces. Furthermore, adversary abilities to control space and use space capabilities need to be considered as part of the joint intelligence preparation of the battlespace (JIPB) process.

• Military planners need to identify those space forces and space capabilities related to centers of gravity (COGs) because OPLANs are oriented on attacking adversary COGs and protecting friendly COGs.

- **Space forces also can be utilized as flexible deterrent options (FDOs).** Conducting a theater ballistic missile defense (TBMD) exercise with US allies is one possible FDO if the combatant commander is facing a TBMD threat. Another FDO could be to publish, in the world media, high-resolution images from commercial satellites and other systems, to clearly demonstrate the adversary’s preparations for war in order to raise public awareness.

DELIBERATE PLANNING PROCESS PHASES

- | | |
|------|--|
| I. | Initiation |
| II. | Concept Development |
| 1. | Mission Analysis |
| 2. | Planning Guidance |
| 3. | Staff Estimates |
| 4. | Commander’s Estimates |
| 5. | Combatant Commander’s Strategic Concept |
| 6. | Chairman of the Joint Chiefs of Staff Concept Review |
| III. | Plan Development |
| 1. | Force Planning |
| 2. | Support Planning |
| 3. | Chemical and/or Nuclear Planning |
| 4. | Transportation Planning |
| 5. | Shortfall Identification |
| 6. | Transportation Feasibility Analysis |
| 7. | Time-Phased Force and Deployment Data Refinement |
| 8. | Documentation |
| IV. | Plan Review |
| V. | Supporting Plans |

Figure V-1. Deliberate Planning Process Phases

- In staff estimates, the Intelligence Directorate (J-2), Operations Directorate (J-3), Logistics Directorate (J-4) and Command, Control, Communications, and Computer Systems Directorate (J-6) planners need to examine, from the perspective of their functional specialties, the role and contributions of space forces in the various phases of the campaign. During preparation of the commander's estimate, space forces and capabilities need to be wargamed along with land, sea, air, and special operations forces to allow the combatant commander to make an informed concept decision. The combatant commander then forwards this concept of operations, via the combatant commander's strategic concept, to the Chairman of the Joint Chiefs of Staff for review and approval. Upon approval, it becomes the foundation of the CONPLAN or OPLAN that is the end product of the plans development phase of deliberate planning.
- The final product of deliberate planning process is a plan that is a complete description of the combatant commander's concept of operations that includes the role of space forces. The basic plan will contain adversary and friendly space capabilities and will identify space systems as COGs (or contributions to COGs) at the strategic, operational, and tactical levels as appropriate.
- **Annex N (Space Operations)** provides detailed information on space forces and their capabilities that the supported commander can use throughout the campaign. The format for Annex N is found in CJCS Manual 3122.03, *Joint Operation Planning and Execution System Vol II: (Planning Formats and Guidance)*. Annex N directly relates to those space support areas included in other places such as Annex B ("Intelligence"), Appendix 3 to Annex C ("Information Operations"), Annex H ("Meteorological and Oceanographic Services"), Annex K ("Command, Control, and Communications Systems"), Annex S ("Special Technical Operations"), and Annex V ("Interagency Coordination").

b. **Support Coordination.** Coordination of space support between the staffs of the supported and supporting commanders is normally established through the designation of a space authority designated by the combatant commander and/or subordinate JFC. The designated space authority will ensure the identification of operational requirements and their inclusion in the appropriate annex. The result of this process is a supportable, valid statement of requirements that can be used by the supporting commander to prepare supporting joint OPLANs.

- During coordination, the operational requirements are evaluated to identify shortfalls in capability, appropriate use of space forces, compliance with national policy, and feasibility of mission success.
- When shortfalls or other limitations are identified, they are forwarded to the Secretary of Defense via the Chairman of the Joint Chiefs of Staff for further coordination, resolution, adjudication, and apportionment.

c. **Supporting Plans.** Once the supported commander develops a joint OPLAN with annexes, the supporting combatant commanders will write CONPLANs in support of the OPLAN. Within USSPACECOM, Service components will write supporting plans to support the CONPLAN. During the development of this plan, consideration will be given to and balanced with planning requirements of all worldwide space users.

- Requirements will be evaluated based on priority of use, alternative solutions, and CJCS or SecDef guidance. The review and approval of the supporting plan are the responsibility of the supported commander.
- If the requirements of the supported commander cannot be satisfied because of planning commitments previously granted to other commanders or agencies, the Chairman of the Joint Chiefs of Staff or the Secretary of Defense will adjudicate and resolve the conflicting requirements.

2. Crisis Action Planning

a. Commander, USSPACECOM, in coordination with the Chairman of the Joint Chiefs of Staff, must make quick decisions and have the capability to plan, direct, coordinate, and control space assets and forces in response to tasking by the Secretary of Defense or emergency situations that affect space assets or missions. Regardless of whether the Commander, USSPACECOM is the supported or the supporting commander, the Commander, USSPACECOM develops an OPORD to conduct operations. Primary responsibility for the OPORD rests with the supported commander, who may use off-the-shelf joint planning documents, such as OPLANs, as the basis for crisis action planning.

b. Space planning must be embedded into the crisis action planning process so that space forces and capabilities are appropriately integrated into each phase of the supported combatant commander's operation. The crisis action planning process consists of the six steps shown in Figure V-2.

c. Specifically, space needs to be considered in the COA development step. The various orders, such as OPORDs, used in crisis action planning all follow the following five paragraph format: situation, mission, execution, administration and logistics, and C2 (CJCS Manual 3122.03, *Joint Operations Planning and Execution*

System Vol II: (Planning Formats and Guidance), Enclosure C). Space forces and capabilities must be incorporated into the following paragraphs of these orders in addition to Annex N and Annex S of the OPLAN.

- **Situation.** Adversary and friendly COG analysis needs to include space systems.
- **Execution.** Articulate how space contributes to the accomplishment of objectives in each phase of the operation.
- **Command and Control.** Articulate the role of military, civil, and commercial satellite communications in C2 of the forces.

d. **During COA development**, as with mission analysis performed in deliberate planning, space planners will assist the JFC in identifying assigned, implied, and subsidiary tasks for space forces. Furthermore, adversary abilities to control space and use space capabilities need to be considered as part of the IPB. Military planners need to identify those space forces and space capabilities that are potential COGs or are critical parts of COGs, because OPORDs are oriented on attacking adversary COGs and protecting US COGs.

e. **In staff estimates**, the J-2, J-3, J-4, and J-6 planners need to examine the role and contributions of space forces, from the perspective of their functional specialties, in the various phases of the campaign. During the COA selection step, space forces and capabilities need to be wargamed along with land, sea, air, and special operations forces to allow the JFC to make an informed COA selection.

f. The final product of crisis action planning process is an OPORD that is a complete description of the JFC's operation, including the role of space forces. The situation paragraph may include adversary and friendly space capabilities and may include critical space systems at the strategic, operational, and tactical levels, as appropriate. The execution paragraph may include the contributions of space systems in each phase of the campaign, from pre-hostilities through post-hostilities.

CRISIS ACTION PLANNING PROCESS STEPS

I.	Situation Development
II.	Crisis Assessment
III.	Course of Action Development
IV.	Course of Action Selection
V.	Execution Planning
VI.	Execution

Figure V-2. Crisis Action Planning Process Steps

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APPENDIX A

INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE

1. Overview

ISR (see Figure A-1) is the collection of data and information on an object or in an AOI on a continuing, event driven or scheduled basis. Collection over relatively continuous periods of time is called surveillance. Collection that is event driven, scheduled over shorter periods, is repeated or occurs on a relatively brief one-time basis is generally referred to as reconnaissance. Orbital characteristics and numbers of systems applied to a target over time can determine whether reconnaissance or surveillance is conducted. The JFC and the components have access to space systems that can collect diverse military, political or economic information that can be valuable for planning and executing throughout the range of military operations (including peacekeeping), humanitarian or disaster relief missions. More specifically, information can be collected, processed, exploited and disseminated on such diverse subjects as indications and warning (to include ballistic missile attack), targeting analysis, friendly COA development, adversary capability assessment, BDA, or battlespace characterization. Types of data and information collected from space can include signals intelligence, communications intelligence, imagery intelligence, electronic intelligence, and measurement and signatures intelligence.

2. Application

a. **Intelligence.** Intelligence is the product resulting from the collection, processing, integration, analysis, evaluation, and interpretation of available information concerning foreign countries or areas. Space systems contribute to the development of intelligence through surveillance and reconnaissance activities.

b. **Surveillance.** Space systems can provide commanders with continuous observation of space, air, surface areas, places, persons, or things by visual, electronic, photographic, or other means that provide commanders with situational awareness within a given area. Surveillance from space does not infer that a single satellite or “system” must be continuously collecting. Satellites that are able to provide a snapshot in time can be augmented by additional systems collecting in the same or even different areas of the electromagnetic spectrum. There will be short gaps in collection (minutes or a few hours), but systems will be concentrating on a target, which, over time, constitutes surveillance. These “following” systems can continue collecting on a target as the previous satellite moves out of the area of access in its orbit. Several satellites in low and medium earth orbits can provide coverage of targets on the order of minutes. Geosynchronous satellites can provide true surveillance, as their orbits allow them to have continuous access to large portions of the earth. Collection from geosynchronous systems may, by necessity, be prioritized based on area of the world and where within the electromagnetic spectrum it can be tasked to collect. In many instances, the number of requirements levied against a system may also necessitate a prioritization of collection. Satellites may also be a contributor to an overall surveillance effort consisting of space, terrestrial, and airborne systems that together provide continuity in surveillance when space systems alone do not have continuous access or are unavailable.

FORCE ENHANCEMENT OPERATIONS — INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE		
APPLICATION	ADVANTAGES	LIMITATIONS
Reconnaissance Surveillance Intelligence	Worldwide access Quick reaction Worldwide access	Atmospheric disturbances Predictable overflight schedule Predictable overflight schedule

Figure A-1. Force Enhancement Operations — Intelligence, Surveillance, and Reconnaissance

c. **Reconnaissance.** Single low and medium earth orbiting systems or architectures that provide limited numbers of low or medium orbital systems are well suited to the reconnaissance mission. Generally their access to specific targets are limited in time based on their orbit, such that data collected will be a “snapshot” of events in the portion of the electromagnetic spectrum where they can collect. Geosynchronous or geostationary satellites are capable of performing reconnaissance from space as well, focusing their collection efforts on a target or region for relatively short amounts of time before focusing on another area.

3. Advantages

a. The prime advantage of ISR space systems is their potential capability to provide continuous and focused coverage of AOIs.

b. Often, the product of a space or terrestrial system can enhance accuracy and reaction times to the user by cueing another space system to survey an AOI. Likewise, a space-based asset may be used to cue a terrestrial-based system for more precise location, discrimination, and targeting.

c. ISR systems also enhance planning capabilities by providing updated information regarding terrain and adversary force dispositions. Space-based imagery in particular supports the full range of military intelligence activities including indications and warning, current intelligence, order of battle, scientific and technical intelligence assessments, targeting and combat assessments. Imagery also is used to conduct mission planning and rehearsal.

See the joint publication (JP) 2-0 series for additional information on space-based intelligence support.

4. Limitations

In addition to the access limitations and a predictable overflight schedule dictated by the satellite orbit, satellite systems may be affected by a variety of atmospheric disturbances such as fog, smoke, electrical storms, and precipitation and clouds, which affect the ability of imaging systems to detect adversary activity, missile launches, and battle damage. Other limiting factors include priority conflicts, processing, exploitation, and dissemination limitations, and low numbers of assets.

5. Support Procedures

There are a number of national, military, and nonmilitary space assets that can be used individually or in combination to provide the information required by the JFC. The support request procedures for products and information are dependent on the individual system.

See JP 2-01, Joint Intelligence Support to Military Operations, for additional information on national imagery sensors and capabilities.

a. **National and DOD ISR Support.** National ISR systems provide direct support to the President. The information provided by these systems is used by senior government leaders to make strategic political or military decisions, and is also of great utility to the JFC. Information from national systems is provided to the JFC by direct and indirect feeds in addition to Service component TENCAP systems. Requests for ISR support should go through the combatant command or JTF J-2 and the J-2 collection manager. Additional sources of information and assistance include the LNO or support team assigned from the appropriate national or DOD intelligence agencies.

b. **Nonmilitary and Commercial Imagery Support.** National and USG civil space-based imagery systems provide most of the imagery support to joint operations. However, nonmilitary space surveillance systems (including commercial and allied space capabilities) may augment DOD space systems, enhancing surveillance and reconnaissance coverage of the Earth.

- Commercial electro-optical imaging satellites are capable of providing large area, mid-resolution images with a revisit time from eight to fifteen days; others are capable of high-resolution imagery with a revisit time of three days. Recent increases in the number and quality of commercial imagery satellites provide a valuable opportunity to augment national systems with panchromatic, MSI hyper-spectral imagery, and radar imagery products. Examples include the land satellite US LANDSAT, the French SPOT (Satellite Pour l’Observation de la Terre), and the Space Imaging Corporation

Ikonos imagery (commercial one-meter resolution panchromatic imagery, with four-meter resolution MSI). All commercial imagery is requested through NIMA.

- The greatest limitation of commercial imagery is lack of available systems. Commercial imagery timelines are not adequate to fulfill most stated theater collection requirements with revisit times between 3 and 14 days. Lengthy revisit times and competition will dictate how long a request for imagery takes to fill, and could take up to a year. In times of conflict these systems could provide an advantage to adversaries, since the sale of information from these systems is often not restricted. The sale of commercial imagery to non-USG customers may be interrupted (i.e., “shutter control”) via the procedures contained in CJCS Manual (CJCSM) 3219.01, *Interruption of Remote Sensing Space Systems Data Collection and Dissemination During Periods of National Security Crisis*.
- NIMA is the sole DOD action agency for all purchases of commercial and foreign government-owned imagery-related remote sensing data by DOD components. To support this, NIMA has established contracts with all major commercial imagery vendors.
- Before commercial products can be relied upon for targeting and accurate geolocations, they should be verified by NIMA. NIMA provides this service on a case-by-case basis. Requests for these services must be validated by the appropriate geospatial information and services (GI&S) staff agency at the combatant command or Service component before being forwarded to NIMA.

c. **Geospatial Information and Services Support.** Joint forces receive current and accurate GI&S information products from NIMA based on satellite imagery. In addition, NIMA can provide supplemental updates to military forces on port conditions, river stages, recent urban construction, vegetation analysis, ice coverage, and oceanographic features. Space-based imagery can provide current information on terrain, surface moisture conditions, oceanic subsurface conditions, beach conditions, and vegetation that permit identification of avenues of approach, specific ingress and egress routes, and other mission parameters to assist in the JIPB.

- Currently, the major source for geospatial data is visible-spectrum imagery provided by national intelligence systems. Imagery provides a detailed overhead view of the area that is analyzed to identify natural and manmade features. Stereo imagery provides elevation data and improved identification of features. Ephemeris and altitude data that accompanies the imagery allows for the precise geodetic positioning of the image and mensuration of features.
- Panchromatic and multi-spectral imagery are contributing sources of data for the development and update of GI&S information. Satellite systems are vital for providing GI&S data because of their global coverage and periodic updates.
- During a crisis, it is important to understand that geospatial information producers are in direct competition with intelligence activities for national collection systems. In some cases, this competition could be mitigated by the use of civil and commercial imagery sources as discussed above.

See JP 2-03, Joint Tactics, Techniques, and Procedures for Geospatial Information and Services Support to Joint Operations, for additional information.

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APPENDIX B

INTEGRATED TACTICAL WARNING AND ATTACK ASSESSMENT

1. Overview

Space forces provide warning of ballistic missile launches. Voice and data warning information is immediately relayed to the warfighter in near real time to support tactical decisionmaking to counter the threat.

2. Application

a. **Theater Ballistic Missile Detection and Warning.** A well organized command, control, communications, computers, and intelligence structure allows commanders to maximize detection and warning of inbound ballistic missiles to ensure effective passive defense, active defense, and attack operations.

- Theater missile warning involves a C2 network capable of functioning within the limited time afforded by the missile event. Other space assets, in addition to sensor satellites, are involved in this process.
- These supporting assets provide communication links which carry raw data, processed data (information), and verbal command directions to warn the affected air, land, sea, space and special operations forces and to coordinate theater missile defense activities. Satellite sensors also accomplish NUDET detection.
- Theater missile warning data is gathered by ground stations, then processed and disseminated over communications networks, including space assets. Deployable missile warning capabilities provide in-theater processing and dissemination of theater ballistic missile warning. Such capabilities (currently JTACS) are available to a geographic combatant commander and/or subordinate JFC.

b. **Requests for Theater Missile Warning.** A JFC requesting missile warning support that is not in an existing OPLAN or CONPLAN, or modifying support already existing in an OPLAN or CONPLAN, should forward requests for theater missile warning to USSPACECOM and/or J-3.

- Requests should include specific threat assessment, location and type of threat, duration of support requested, primary and secondary communications media preferred for reporting, false reporting tolerance, and levels and units within the command structure to which the warning data and information will be provided.
- Upon receiving a request, USSPACECOM will assess the **missile warning sensor capabilities** and actions necessary to enhance detection. This assessment is based on preliminary information and the most current intelligence evaluations.
- Preliminary assessments also examine the means by which missile warning information can be disseminated to the theater. Theater assets and assets deployable to theater should receive primary consideration in receiving this warning.
- Close coordination is essential to the development of a responsive warning system. During development of operational requirements, specific reporting criteria must be established to include the following.
 - Warning timeliness.
 - Sequence of information.
 - Location of threats and forces (latitude and longitude vice general area).
 - Launch direction to area at risk.
 - Reporting for high confidence data.

- Broadcast vice point-to-point reporting.
- False report tolerance.
- From these criteria, specific operational coverage and procedures are put into place to best satisfy the requested missile warning support within the limitations of sensors and the theater's communications media and data requirements (see Figure B-1).

c. Missile Detection and Warning Exercise Support

- **Exercise Design.** The theater event system (TES) elements will use operational hardware, software, and procedures to the maximum extent possible for exercises. For each exercise requiring TES support, USSPACECOM will determine, after taking into account the wishes of the requesting agency, if the TES processor elements or a simulation device will support the exercise. USSPACECOM will provide the Missile Warning Center, theater, and all participating TES elements or simulation organizations with the missile launch scenario, the voice reporting architecture, and templates (if different than real-world).
- **Exercise Coordination.** Coordination with USSPACECOM is required prior to TES elements or simulation systems injecting exercise traffic. USSPACECOM will review and approve or disapprove exceptions on a case-by-case basis. USSPACECOM is responsible, once the exercise is approved, to ensure that a users message is released announcing the exercise specifics.
- Dissemination of exercise data over the Integrated Broadcast Service broadcast requires separate approval and coordination.
- The TES elements must keep exercise and real-world data separate and clearly defined.

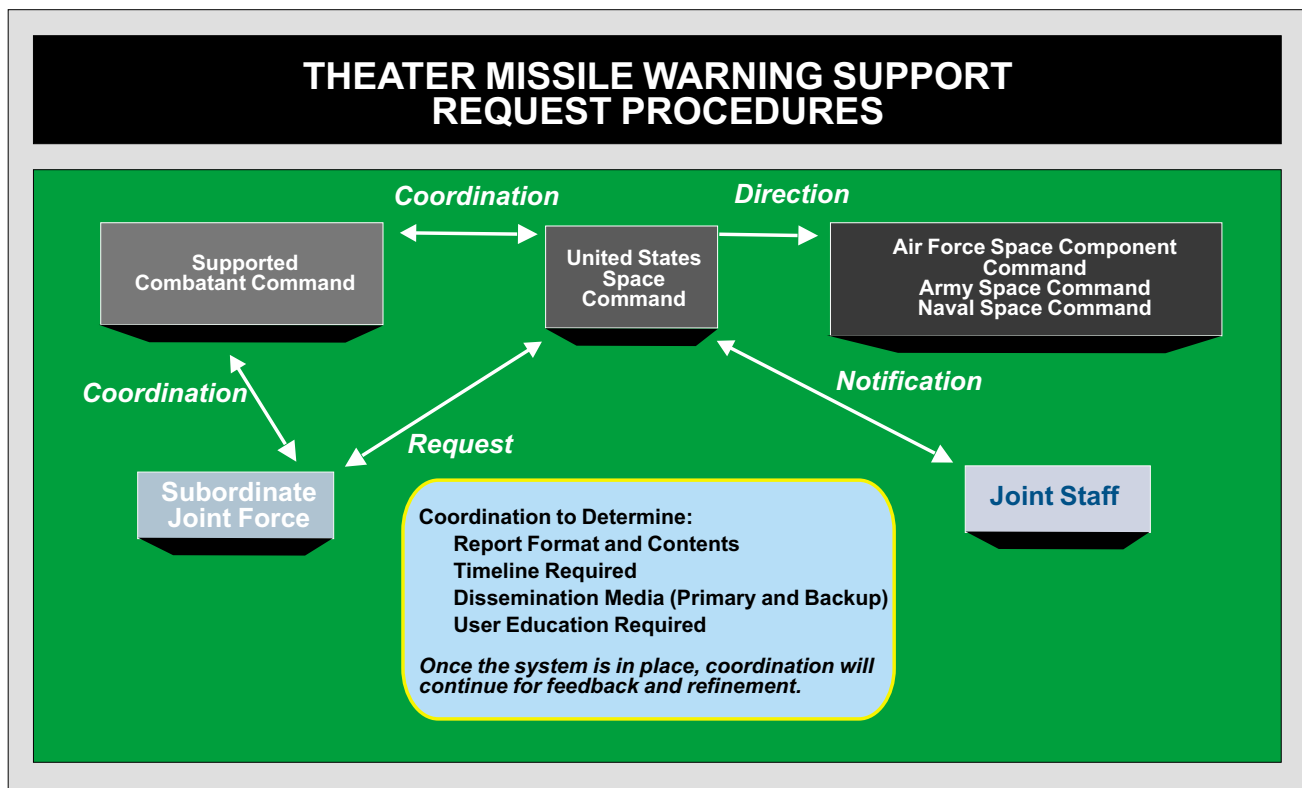


Figure B-1. Theater Missile Warning Support Request Procedures

d. **Shared Early Warning.** The United States exchanges missile detection and warning information with its allies and coalition partners. The objective of Shared Early Warning (SEW) is the continuous exchange of missile early warning information derived from US missile early warning sensors and, when available, from the sensors of the SEW partner. Information on missile launches is provided on a near real time basis and is approximately the same quality and timeliness as that which would be provided to US forces if colocated. This information can take the form of data, voice warning, or both.

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APPENDIX C

ENVIRONMENTAL MONITORING

1. Overview

Space systems are the JFC's primary and sometimes sole source of environmental data. METOC support from space is critical to the development of weather forecasts and assessments of the impact on both friendly and adversary COAs (see Figure C-1). Weather satellite systems use satellites in sun-synchronous and geosynchronous orbits.

2. Application

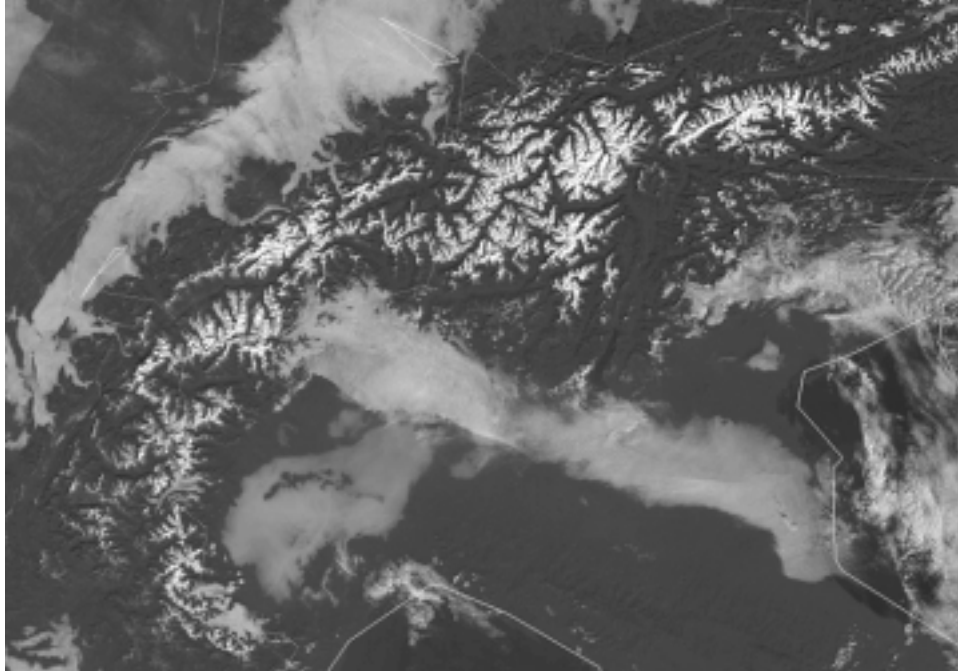
a. **Weather.** Space-derived meteorological information is crucial to understanding and reacting to the effects of the environment on operations. This information helps commanders assess the environmental impacts on both friendly and adversary forces alike and helps to complete the battlefield picture. Weather affects mission timing, route selection, target and weapon selection, mode of weapon delivery, communications, reconnaissance, and surveillance.

b. **Oceanographic.** Knowledge of the location and characteristics of oceanographic features such as sea heights, sea surface ice, currents, fronts, and eddies are critical for undersea warfare operations and can be used by the commander to avoid submarine or maritime mine threats and to concentrate forces in an area where an adversary is most likely to be operating. This knowledge can also be used by friendly forces to optimize search and rescue operations at sea and to help determine optimum locations for amphibious landings.

c. **Space Environment.** Observation of the space environment is crucial to specifying and forecasting conditions in space and contributes directly to battlespace awareness. This provides an additional degree of space superiority by enabling US military joint forces to determine the impact of environmental factors on both adversary and friendly space and weapons systems. Like terrestrial weather forecasting and analysis, this capability "reduces the fog" about when US systems may be affected. Consequently they may be degraded for friendly use and the situation exploited by an adversary.

FORCE ENHANCEMENT OPERATIONS — ENVIRONMENTAL MONITORING		
APPLICATION	ADVANTAGES	LIMITATIONS
Weather data	Access to remote and/or hostile areas	Required information limited; limited data refresh rate for high resolution
Oceanographic data	Multi-Spectral Data	Limited polar coverage
Space environment data	Direct measurement of physical environment	Limited coverage compared to remote sensing
Disaster monitoring	Direct survey of affected region	Limited resolution and dwell time over affected area

Figure C-1. Force Enhancement Operations — Environmental Monitoring



Meteorological information from space sensors is a critical factor in planning and executing joint operations.

3. Advantages

- a. A prime advantage of environmental satellites is their ability to gather data regarding remote or hostile areas, where little or no data can be obtained via surface reporting stations.
- b. Weather satellites have a limited multi-spectral capability, typically gathering data in visual, infrared, and microwave spectral bands. Infrared sensors provide images that are based on the thermal characteristics of atmospheric features (such as clouds) and Earth features, such as land masses and water bodies. This data can be used to calculate the altitude of cloud tops and ground or water surface temperatures.
- c. Thermal and visible images together provide the coverage and extent of clouds at various levels, as well as other physical phenomena such as ice fields and snow. Current microwave sensors are used to measure or infer sea surface winds (direction and speed), ground moisture, rainfall rates, ice characteristics, atmospheric temperatures, and water vapor profiles.

4. Limitations

- a. Polar-orbiting satellites have periodic revisit rates over the target area as well as limited time over target for observations. Geostationary satellites provide low resolution images.
- b. Moreover, the image quality of geosynchronous satellites degrades as distance and angle from the point directly under the satellite increases. As a result of the increased angle, coverage at polar latitudes is poor or nonexistent.
- c. Some meteorological parameters needed by forecasters for operational support cannot currently be accurately determined from satellites, including heights of cloud bases and visibility restrictions.

5. Support Procedures

- a. Weather, oceanographic, and space environmental support to joint operations are normally provided by METOC units assigned to one or more of the participating components. When two or more METOC units are involved, coordination of their support is normally accomplished by the joint force senior METOC officer.



Defense Meteorological Satellite Program

b. METOC units receive environmental data from a variety of sources including weather satellites. Weather satellite systems collect and disseminate global visible and infrared cloud data and other specialized meteorological, oceanographic, and solar-geophysical data.

c. Weather satellite system data is supplied to the Air Force Weather Agency and Navy Fleet Numerical Meteorology and Oceanographic Center (FNMOC) and to fixed and deployed mobile ground and ship-based tactical data receipt and processing terminals supporting operational forces worldwide.

d. Central facilities provide users with real-time and stored weather satellite cloud imagery, processed products, and satellite information incorporated in other environmental products. The Air Force Weather Agency is responsible for collecting, processing, and providing space environmental data products to warfighters from all Services.

e. Weather satellite system data is distributed to deployed weather units over secure and unsecured data and facsimile links or the FNMOC to ship communications links. Typically the JFC, through the joint force METOC officer, coordinates the requirements for this support during deliberate and crisis action planning.

f. Another source of weather satellite system information for joint operations is direct downlink of real-time Defense Meteorological Satellite Program data to transportable tactical terminals employed by the Services.

"Weather satellites played a key role during the war. US and Coalition forces used data from the Defense Meteorological Satellite Program spacecraft and civil weather satellites to predict rapidly changing weather patterns. Meteorological satellites were the most reliable sources of information on weather in Iraq. The information provided was used extensively to plan and execute attack missions, to determine wind direction and potential spread of chemical agents, and to alert US forces of sandstorms or other phenomena."

DOD Report to Congress, *Conduct of the Persian Gulf War*, Vol II, Apr 92

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APPENDIX D COMMUNICATIONS

1. Overview

JFCs must have the capability to communicate over long distances with assigned, attached, and supporting air, land, sea, space, and special operations forces. Because JFCs are likely to operate in areas without an existing survivable communications infrastructure, satellite communications are often the only means of providing critical beyond LOS C2. Satellite communications — military, commercial, and civil — collectively provide near-global coverage, which affords the Secretary of Defense and top military leaders with a means to maintain strategic situational awareness and convey their intent to the operational commander responsible for conducting joint operations in a specific area (see Figure D-1). Satellite communications also provide critical connectivity for tactical maneuver forces whose rapid movement and non-linear deployments take them beyond inherent LOS communication networks reach. Satellite communications may assist with Special Communications operations — the relay of US, allied or coalition signals from or into areas typically characterized by an intense counterintelligence environment, usually in support of covert and clandestine intelligence or military operations.

2. Application

a. Satellite communications collectively provide an **essential element** of national and DOD communications worldwide. They allow for information transfer from the highest levels of government to the theater tactical level for all matters to include operations, logistics, intelligence, personnel, and diplomacy.

- They support a variety of media, from television to interactive computer to digitized voice.

FORCE ENHANCEMENT OPERATIONS — COMMUNICATIONS		
APPLICATION	ADVANTAGES	LIMITATIONS
Ultra high frequency, super high frequency, and extremely high frequency communications	Near global coverage Near real time transmission Data relay broadcast Security Flexibility Support mobile forces	Capacity Orbital considerations Frequency constraints Host nation approvals Terminal and antenna size Constellation reconfiguration Sensitive to solar activity Jamming susceptibility

Figure D-1. Force Enhancement Operations — Communications

- To a user, the satellite should be **transparent**; it does not create information, but is only a carrier. The frequency band and waveform of a signal influences the throughput capacity and the degree of protection provided to the communications system (anti-jam (AJ), low probability of intercept (LPI), and low probability of detection (LPD) capabilities).

“At the beginning of Operation DESERT SHIELD, CENTCOM satellite usage was very limited. Once Operation DESERT STORM began, satellite usage increased over a hundredfold. In excess of 1,500 satellite communications terminals were deployed to theater, of which over 75 percent were single-channel man-portable military and commercial units. The satellite usage requirements were for both inter- and intra-theater communications. Intra-theater satellite communications were especially important because of the vast operational area in which there did not already exist a communications infrastructure. Fifty percent of the satellite communications traffic was carried by over 100 DSCS terminals. Large commercial [International Telecommunications Satellite] terminals provided another 25 percent. The remaining 25 percent included [Fleet Satellite Communications], [Air Force Satellite Communications System], and commercial [International Maritime Satellite] man-portable terminals.”

Combined Arms Command Center for Army Lessons Learned, Space Support to the Army, Lessons from DESERT SHIELD and STORM: Oct 91

- The frequency bands over which the military satellite communications (MILSATCOM) operate are UHF, SHF, extremely high frequency (EHF), the military Ka band, and the commercial L- and S-bands for narrowband communications as well as the commercial C-, Ku-, and Ka-bands for wideband communications (which correspond to SHF).
- b. **Narrowband satellite communications** systems support secure voice and data transmission at relatively low data rates for both mobile and fixed users by providing access on a single dedicated channel or on a demand assigned multiple access channel.
- Narrowband communications traditionally supported such requirements as emergency action message dissemination between the Secretary of Defense and combatant commanders, force direction messages, tactical C2, low data rate broadcast, and force report-back message transmission and reception.
 - Narrowband systems support highly mobile, tactical users. Compact terminal equipment and omni-directional antennas allow deployed warfighters to quickly and efficiently exchange both voice and data communications.
 - Narrowband systems include mobile and fixed terminals installed in air, sea, and ground platforms; command centers and command posts; and missile launch control facilities.
- c. **Wideband satellite communications** support multi-channel, secure voice, and high data-rate communications for C2, crisis management, and intelligence data transfer service between the Secretary of Defense, the Chairman of the Joint Chiefs of Staff, and combatant commanders.
- Wideband communications are also used in communications among the combatant commanders; between the combatant commanders and their component forces; and from early warning sites to correlation and operations centers.
 - The heaviest use of wideband communications is multiplexed, wideband, switched networks. Many wideband users employ large, fixed ground terminals to support DOD enterprise-wide voice, data, and video wideband networks. Smaller mobile and relocatable terminals support exercises and deployed operations requirements of tactical forces for high-capacity, multi-channel communications aboard ships and aircraft as well as in support of ground forces.
- d. **Protected satellite communications** support survivable voice and data communications not normally found on other systems.
- Although the general capabilities of protected satellite communications in a peacetime environment are less than wideband, in a hostile environment where a wideband system could be degraded protected satellite communications will allow survivable communication, but at a reduced data rate.



Deployable super-high frequency satellite ground station.

- Protected satellite communications characteristics, such as its narrow beamwidth and use of spread spectrum and frequency hopping, give it capabilities such as AJ and scintillation-resistance along with LPI and LPD. Due to these unique capabilities, the use of the protected satellite communications frequency band has often been associated with the most critical strategic forces and C2 systems.
- Protected satellite communications also permits the use of smaller antennas that increase its mobility, enabling wider use of manpack, submarine, airborne, and other mobile terminals.

e. **Commercial Capabilities.** The rapid pace of advancements in more capable and more affordable commercial SATCOM technology is offering new, even revolutionary capabilities that can be exploited to meet the Department of Defense's rapidly growing information needs. Many SATCOM requirements are therefore expected to be satisfied more economically by commercial means. Some wideband services and personal communications services (e.g., "cell phones") are examples of current commercial SATCOM support to strategic and tactical mobile users (e.g., International telecommunications satellite organization and international maritime satellite). Commercial systems should also be good candidates to support much of the Department of Defense's predictable, wideband, fixed SATCOM needs requiring little or no AJ protection or US control. Leasing commercial services may also afford the Armed Forces of the United States faster access to advanced capabilities and services than traditional government research, development, and acquisition programs. The new commercial broadband interactive systems currently being built are an example of this. However, in an environment where both the United States and its potential adversaries will have almost equivalent access to the same advanced technologies and commercial services, sustaining military advantage may largely rest on US ability to integrate those technologies and commercial services into its force structure faster and more effectively than the adversary can.

3. Advantages

The inherent capabilities of satellite systems provide significant advantages over other communications systems.

a. **Global Coverage.** Collectively, satellite communications systems provide global coverage. If required, satellites can provide focused capacity in areas of special interest.

b. **Real Time Transmission of Voice and Data.** Like other communications media, most satellite communications systems provide real-time connectivity for both voice and data.

c. **Data Relay.** Satellite communications links preclude the need for long terrestrial communications links and the requisite multiple HN approvals and tariffs to move US communications around the globe. Furthermore, SATCOM enables US forces to communicate without substantial difficulties or issues into and across hostile territory or difficult terrain.

d. **Security.** DOD policy requires secure satellite communications networks. Users may not enter a satellite network without the signal being encrypted, requiring external encryption devices at the terminal. The larger bandwidth SHF systems use bulk encryption devices to encrypt large amounts of information that have been multiplexed prior to transmission.

e. **Flexibility.** Satellite systems allow near-global coverage and inter-linking between frequency bands and systems and certain systems are able to provide a relatively LPD. Flexibility gives the JFC a great deal of latitude in mixing and matching satellite systems to meet specific operational requirements. Directional antennas afford LPD; wide bandwidths allow higher data rates; ground stations permit cross patching; and satellite positions make near-global coverage available.

f. **Support to Mobile Forces.** SATCOM systems can provide the high capacity communications required by mobile forces operating over wide areas. This is especially true for those forces that require dynamic C2 when they are on the move.

4. Limitations

Satellite communications have the following limitations.

a. **Limited Capacity.** Requirements for SATCOM service worldwide exceed the capacity of current MILSATCOM systems. Through partnering, the Department of Defense can supplement SATCOM capabilities with commercial, international, and civil systems.

- MILSATCOM systems support the Secretary of Defense, the Chairman of the Joint Chiefs of Staff, national and DOD agencies, and combatant commanders worldwide. Due to the number of SATCOM users, the priority of use, and the criticality of information carried over these systems, oversight through requirement validation and adjudication is required at the DOD and Joint Staff levels.
- Identified requirements are carefully scrutinized through a **validation process**, with capacity being apportioned based on priority and availability.
- Within their allocated capacity, combatant commanders manage, direct, and control individual networks supporting component air, land, sea, space, and special operations forces.

b. **Orbital Considerations.** Most DOD communications satellites are in geosynchronous orbits where high latitude polar coverage is limited. Many lie in the equatorial plane (known as “geostationary” orbits) and appear to be stationary over a point on the Earth’s equator.

- A constellation of three geostationary communications satellites equally spaced, or nearly so, within the geostationary orbital belt can provide near-total Earth coverage between 65 degrees north and south latitude. However, outside these latitudes (i.e., in the polar regions) communications coverage is marginal.
- In general, a mix of geostationary and polar satellites is required for full global coverage. A mixture of satellites in low-altitude, highly elliptical, and/or geostationary orbits can also provide global coverage.

c. **Frequency Constraints.** Space systems, similar to terrestrial radio systems, may face HN frequency use limitations. Prior to use of a ground terminal in an HN frequency approval must be granted by the HN. Some countries may require approval for both transmit and receive frequencies. Most countries require long lead times because of difficulties in coordinating frequency deconfliction and the limited portion of the overall radio-frequency spectrum in which SATCOM operates as compared to terrestrial communications.

d. **Terminal and Antenna Size.** Because of antenna size, frequency, bandwidth, and data rate capacity are interrelated, commanders often must compromise either information flow rate or mobility.

- Generally, the higher the frequency (e.g., SHF, EHF), the wider the available bandwidth and the higher the data rate capacity. Similarly, within these frequency bands, the larger the antenna size the greater the data throughput, but the smaller a SATCOM terminal's mobility. However, small terminals and antennas are required to minimize the impacts on tactical force mobility and to ensure that the many different platforms of the supported forces are suitably integrated in the operational, physical, power, and electromagnetic environments. Hand-held and/or man-pack, maritime, and airborne platforms have especially demanding constraints.
- Lower frequency systems have narrower bandwidth and **lower data rate capacity**. This narrower bandwidth may allow generally **smaller antenna sizes**. An exception is the Global Broadcast Service (GBS). GBS has a high data rate going through a small antenna and uses a dedicated high power transponder.

e. **Susceptibility to Jamming and Interference.** All radio receivers, including satellite systems, are susceptible to jamming and interference. Unintentional interference can be as deleterious to SATCOM operations as deliberate jamming, especially since many SATCOM systems must share their frequency bands with other systems. Sometimes jam resistance schemes may be used; however, they significantly reduce data throughput. One AJ technique is an antenna nuller. Nullers work by reducing the sensitivity of the satellite's antennas to transmissions being transmitted from a selected geographic area. How well the nullers work depends on how close the jammer is to friendly terminals. Nulling antennas are somewhat complex and expensive and thus are not suitable for every type of satellite.

- **Narrowband satellites** are the most susceptible to both jamming and intercept due to their narrower bandwidth, large antenna beamwidth, and low power. While most commercial satellites have no protection against jamming, some transponders installed on military UHF satellites have limited resistance through different modulation schemes and frequency hopping techniques.
- **Military wideband** systems operate at higher frequencies, smaller antenna beamwidths, and wider bandwidth. This allows the incorporation of more effective modulation schemes that provide a higher degree of jam resistance. Some satellites have antenna nullers that can further reduce susceptibility to jamming on a limited set of transponders.
- **Military protected** systems afford even greater protection through the different techniques possible with wider available bandwidth and antenna nullers.

f. **Constellation Reconfiguration.** While the ability to move satellites to reconfigure constellations may be an advantage, there are also significant disadvantages to repositioning satellites.

- Most communications satellites currently in service are positioned to provide communications connectivity to a large number of users. Moving any of the primary satellites to a new satellite region could **disrupt communications** connectivity for this population and could impair their ability to accomplish their missions. Movement of satellites should be coordinated with the ITU to deconflict locations.
- Repositioning satellites can take weeks and can **consume a significant amount of on-board, station-keeping fuel**, reducing the operational life of the satellite. To offset this limitation, JFCs should identify their needs for satellite communications support or revised coverage as soon as possible so changes can be made in the most efficient manner in coordination with the SATCOM system operational manager (SOM) USSPACECOM.

g. **Solar Activity.** Heavy solar activity can disrupt satellite communications for short periods of time. For example, solar activity-induced electrical charging of the ionosphere and irregularities in the upper atmosphere can cause fluctuations (scintillation) in the signal strength and phase of ground-to-space and space-to-ground communications links. In extreme cases, this can cause communications outages.

- The detection of solar flares can be used to forecast solar effects, thereby minimizing the disruption of communications by using work-arounds.

- Sun activity mostly affects small receivers in the Arctic and tropical regions as well as the UHF frequency band.

h. **Interference Due to Rain.** SATCOM in the Ku- and Ka- bands, as well as EHF systems, are particularly affected by rain (the higher the frequency, the greater the effect). Rain not only degrades the signal but, if heavy enough, can cause a complete outage. While the percentage of time a system will be non-available to rain is small (ranging from a few percent of the time to less than one percent, depending on climatic region), this is a constraint which must still be accounted for operationally.

i. **Sun Conjunctions.** Sun conjunctions and the communications disruptions and outages they cause arise when the sun comes into view of an Earth terminal's antenna. Essentially the sun operates on the terminal as a huge noise source behind the satellite, the strength of which overpowers the satellite's signals. Conjunctions occur each year around the time of the vernal and autumnal equinoxes. For a period of a few days around each equinox and for a few minutes each day, disruptions and outages will occur. Since their time and duration can be predicted, such events can be planned for and their impact on operations minimized.

j. **Considerations for Military Use of Commercial SATCOM Systems.** Not all DOD communications needs can or should be met by commercial means, especially in an unpredictable threat environment. Competition for access with other customers (to include adversaries), non-US ownership or control of commercial SATCOM services outside the borders of the United States, and either the lack of or inability to quickly access commercial SATCOM capacity in many areas to which the military could deploy (often on a short notice) raise substantial questions about the Department of Defense's ready assured access to those services when and where needed. Enduring, largely military-unique needs include nuclear survivability; coverage of the polar regions, open oceans, and other remote areas of the world; dynamic support of a large deployed infrastructure of mobile and relocatable users; and the need for secure, protected, and/or covert communications (e.g., LPI and LPD, AJ, and anti-scintillation). Once obtained, access and availability to commercial services are based on the terms of the lease or contract that could be terminated at militarily inconvenient times. Experience has demonstrated that foreign commercial telecommunications media may sometimes become unreliable during periods of political tension or open hostilities. MILSATCOM is essential to the intelligence and diplomatic communities and many warfighting functions to provide worldwide transmission of critical intelligence data and sensitive diplomatic traffic to and from the United States over communications paths that remain under the direct control of the United States, especially during times of political tension or crisis.

k. **Consideration for Military Use of National Systems for Communications.** In some cases, specialized DOD communications needs can be met through national systems (e.g., some Special Communications activities). As with military SATCOM systems, these assets may be highly subscribed and require careful coordination and planning with national systems operators before military use can be ensured.

5. Support Procedures

The SATCOM requirements process is vital to proper DOD management of all aspects of SATCOM systems. The process through which SATCOM and commercial SATCOM requirements are approved and documented is described in the following paragraphs. The access process is also described. Key elements of the process include a standardized method of stating requirements, CJCS validation of approved requirements, a central repository of approved requirements, and guidance for gaining access to SATCOM systems.

a. **Requirements Process.** Under the **deliberate** planning process, the combatant commanders are apportioned SATCOM resources on a global and theater basis for support of OPLAN development. The actual allocation of SATCOM capacity will be based on the current operational situation, threat conditions, and operational requirements (see Figure D-2).

- The Chairman of the Joint Chiefs of Staff, Commander, USSPACECOM, other combatant commanders, Services, and DOD agencies are the advocates of all military satellite communications requirements.
- The combatant commanders are the advocates for their respective requirements. Each combatant commander will consolidate, validate, and prioritize all requests for use of SATCOM systems within their AOR.
- Combatant commanders and Services with specialized communications needs, such as special communications, that utilize national systems will validate their requirements and submit them to the Joint Staff.

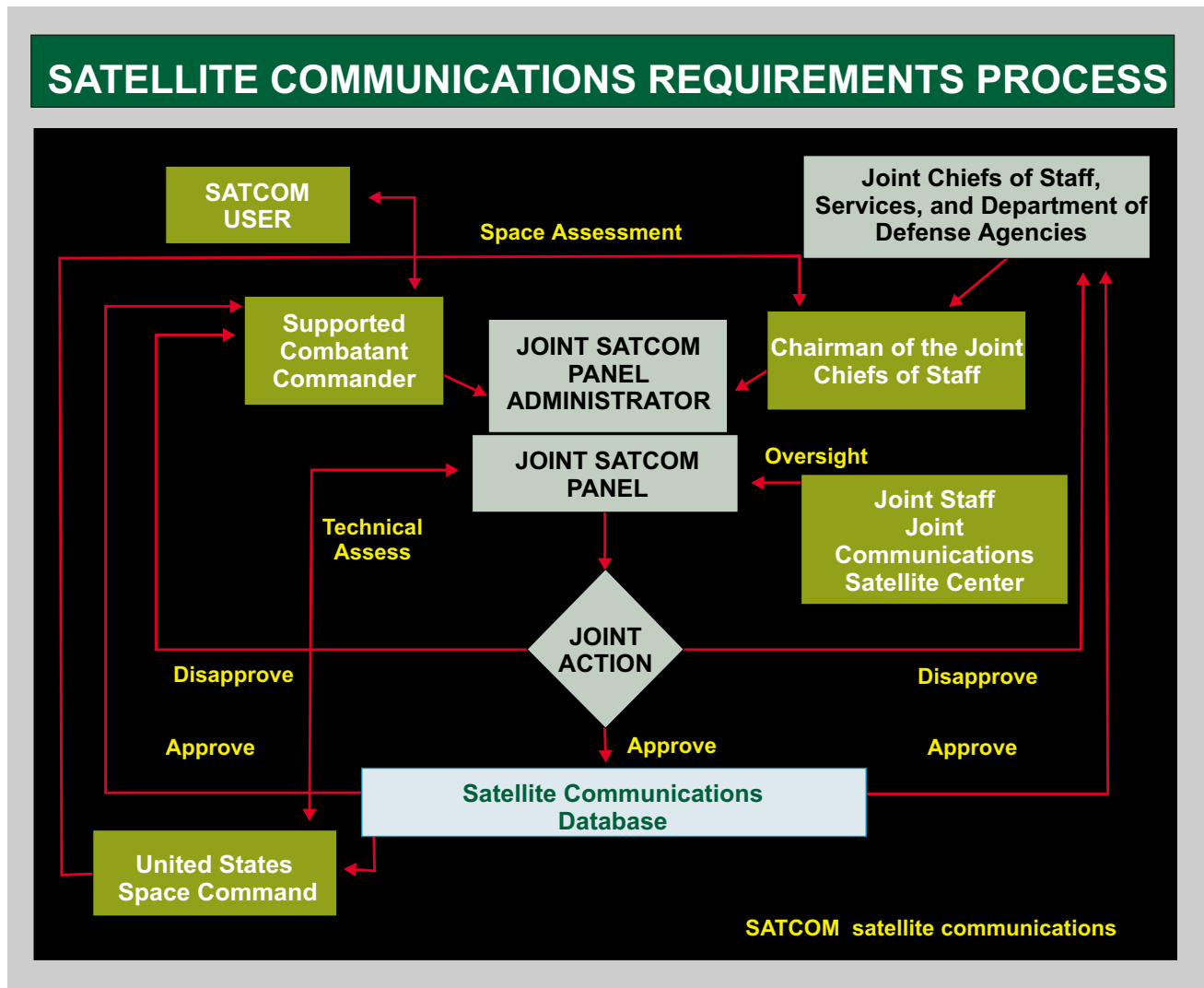


Figure D-2. Satellite Communications Requirements Process

- The Services will validate and submit, through Service channels, Service-unique requirements.
- DOD agencies will validate and submit to the Joint Staff requirements in support of their agency mission and/or function.
- Assistant Secretary of Defense (Command, Control, Communications and Intelligence) (ASD(C3I)) is responsible for non-DOD and Federal agency requirements.

b. **Format.** Requirements for SATCOM system connectivity are submitted as described in the Telecommunications Management System — Classified SATCOM Tool Kit Manual (prepared by DISA).

c. **Prioritization.** Combatant commanders, Services, and agencies review each requirement to ensure that it is valid, has a clear operational concept, identifies the operational needs and missions supported, and provides a mission impact if not satisfied. The requirements are then prioritized by category as prescribed and documented in CJCS Instruction (CJCSI) 6250.01, *Satellite Communications*.

d. **Submission.** All SATCOM (military and commercial) requirements are submitted to the Joint Staff through the joint SATCOM panel administrator (JSPA) at DISA who administers the Satellite Communications Database (SDB).

- Requirements are reviewed and a recommendation is made for approval or disapproval to the Chairman of the Joint Chiefs of Staff.
- CJCS-approved SATCOM requirements are entered in the SDB. This database supports day-to-day operational management of all SATCOM systems and wartime deliberate planning requirements.
- Non-DOD and Federal Agencies requirements will be submitted to the ASD(C3I). If ASD(C3I) concurs with the requirement, it is forwarded to the Joint Staff for review and action via the normal process.

e. **Future Requirements.** Future connectivity requirements are satisfied through ongoing changes to strategy, doctrine, forces, weapon systems, or changes in technology. The SDB consolidates future SATCOM requirements to assist planners in determining future SATCOM capabilities, trends, architectures, and acquisition strategies. Format and submission procedures are similar to the SDB process described previously.

f. **SATCOM Access.** Access is requested via the operational access process described in the SATCOM system control and operations concept document.

g. **Adjudication.** The Chairman of the Joint Chiefs of Staff has final adjudication authority over competing requirements for SATCOM access. Joint Staff and the Joint Communications Satellite Center administer the adjudication process and advise global and regional SATCOM support centers on which users to preempt when required.

h. **Urgent Requirements.** For urgent requirements not documented in the SDB, a request is submitted directly to the Joint Staff J-6, with information copies to JSPA. Urgent requirements can be submitted by combatant commands, Services, and DOD agencies, but must be validated as an operational necessity by the appropriate combatant command. The request must contain justification for urgent processing. For urgent requirements, the Joint Staff can grant a 30-day waiver for SDB approval.

i. **USSPACECOM Responsibilities.** USSPACECOM is the SOM responsible for establishing the integrated SATCOM support centers for both global and regional direct support to the combatant commands and other users (CJCSI 6250.01, *Satellite Communications*). Additional responsibilities include the following.

- The SOM develops and implements standards, policy, and procedures for all SATCOM systems.
- The SOM, supported by the SSEs, will provide the integrated SATCOM management infrastructure. In addition, the SOM is responsible for establishing a global SATCOM support center and regional SATCOM support centers, as required, to provide support to combatant commands and other users. These centers will be incorporated as part of the overall Defense Information Systems Network management and control system.
- The SOM prepares SATCOM apportionment recommendations for the Joint Staff in conjunction with the combatant commands and other users. Additionally, the SOM manages day-to-day operation of apportioned and non-apportioned SATCOM resources in accordance with direction from the Joint Staff, supported combatant commands and other users, and DISA's operational elements.
- USSPACECOM and DISA will collaborate to establish an end-to-end communications one-stop-shop to ensure integration of the SATCOM support centers with the existing DISA global and regional offices.

APPENDIX E

POSITION, VELOCITY, TIME, AND NAVIGATION

1. Overview

Space-based position, velocity, time, and navigation systems, in combination with terminal units, support strategic, operational, and tactical missions by providing **highly accurate**, three-dimensional **position** capability, **velocity** determination, and **time reference** (see Figure E-1).

a. GPS satellites broadcast navigation information on a continuous basis. The transmission has **two levels of service** — a standard positioning service (SPS) and a precise positioning service (PPS).

- **SPS**, which utilizes the Course Acquisition (C/A) code, is the civilian positioning and timing service that is provided to all GPS users at an accuracy level set by the Department of Defense. This level of accuracy can be adjusted through a technique called selective availability (SA). SA is the intentional degradation of the signal-in-space by altering the satellite's clock frequency or by corrupting the navigation data provided in the signal. SPS currently requires one downlink (L1), but the Air Force plans to add C/A-code on L2 in the near future. A third civil frequency (L5) will be added as part of GPS modernization (after 2005).
- **PPS** is a highly accurate military positioning, velocity, and timing service available to authorized users on a worldwide basis. Access to PPS is controlled by use of cryptography. With SA set to zero, the SPS signal accuracy is nearly identical to that of PPS. PPS requires two downlinks (L1 and L2). The positioning code permits very precise matching of receiver-generated and satellite-generated waveforms, hence, precise measurement of the distance to each satellite. When military requirements dictate, the "P" (precision) code is encrypted so that only specially configured military receivers can use it. Encrypted "P" code is called "Y" code. As part of GPS modernization, a more robust Military code (M-code) will be added to the next generation of GPS satellites.

b. **DOD Policy for SPS.** On May 1, 2000, SA was set to zero by Presidential Decision Directive. However, the accuracy of the SPS signal may still be degraded by direction of the Secretary of Defense during times of hostility or conflict.

c. **DOD Policy for PPS.** Congress through public law has directed that after 30 September 2005, all future DOD aircraft, ships, combat vehicles, and indirect-fire weapon systems must be equipped with a GPS receiver. PPS was designed primarily for use by the US military and its allies. However, certain federal civil agencies are also authorized use of the PPS through department level special agreements.

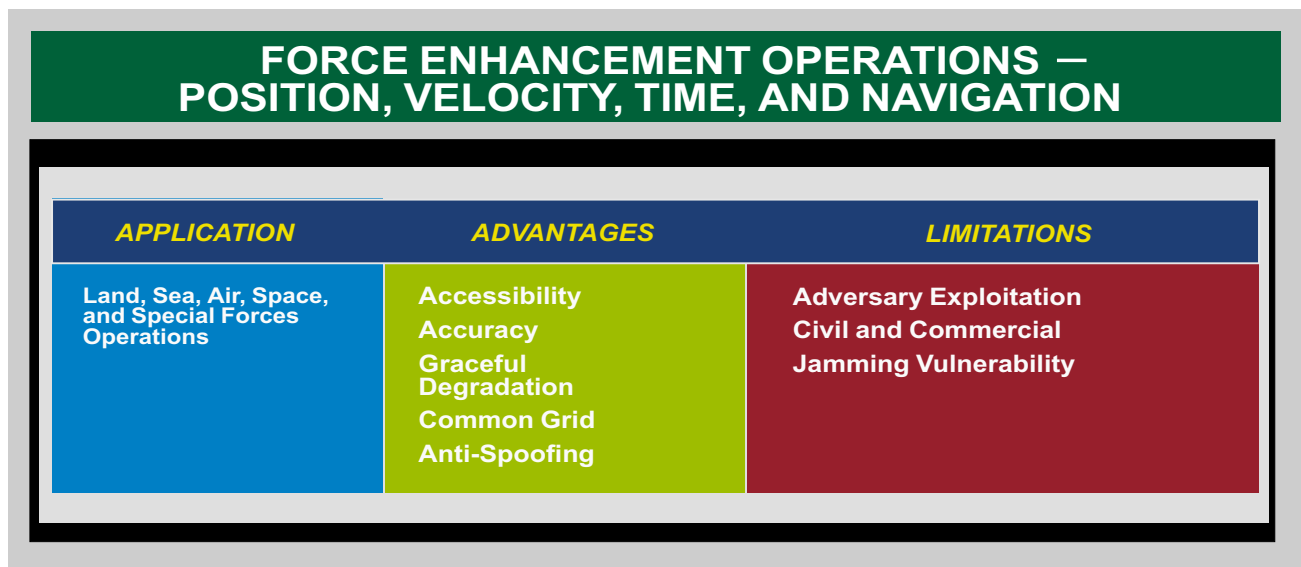


Figure E-1. Force Enhancement Operations — Position, Velocity, Time, and Navigation

2. Application

Designed as a military force enhancement asset, the GPS provides the JFC with a multitude of applications. From precisely fixing friendly force locations in a night, adverse weather environment to employing precision munitions against adversary targets, GPS now plays a key role in most military missions.

a. **Operations on Land.** The inherent precision of GPS allows precise site surveys, emplacement of artillery, target acquisition, and location. GPS establishes a “common grid” within the operational area, can establish a “common time,” help establish “common direction,” and can facilitate synchronized operations.

“This [GPS] was the biggest combat multiplier on the battlefield.”

“The GPS aided Field Artillery survey by providing a third-order control network in theater and by locating firing sites”

Army field commanders, quoted by Combined Arms Command, Center for Army Lessons Learned, Newsletter 91-3, *The Ultimate High Ground! Space Support to the Army: Lessons from Operations DESERT SHIELD and STORM*, Oct 91

- Mine fields and obstacles can be accurately surveyed, emplaced, and recorded.
- The accuracy of artillery fire is improved through precise gun emplacement, precision gun laying and observer location, and a reduction in adversary target location error.
- Armored units can travel “buttoned-up” and maintain highly accurate position awareness.
- Logistic support is enhanced by exact location and navigation information as well as expediting resupply efforts and the evacuation of wounded to aid stations.

b. **Operations at Sea.** Naval forces also benefit from GPS.

- Ships and submarines can precisely plot their position allowing safe port operations and navigation through restricted waters.

“[My destroyer] was equipped with a prototype (GPS) receiver. . . . GPS, in conjunction with . . . onboard inertial navigation system, provided critical redundancy and confidence in our Tomahawk engagement planning for the initial strikes on Baghdad. . . . The accuracy of the GPS system gave me confidence to maneuver in shallow water . . . (and provided) accurate locating data for drifting mines when discovered and destroyed.”

Letter, CAPT Pat Garrett, USN, Commanding Officer of the Destroyer USS Leftwich (DD-984), 16 April 1992

- Coastlines can be accurately surveyed using a combination of laser range finding along with highly accurate position information.
- Mines can be laid and precisely plotted for friendly force avoidance and later retrieval.
- Rendezvous at sea (e.g., submarines and submarine tenders), sea rescue, and other operations can be facilitated using space position, velocity, time, and navigation support.

c. **Operations in the Air.** GPS is also extremely useful in air operations.

- Information on position, velocity, and time enhances airdrop, air refueling, search and rescue, reconnaissance, terminal approach and recovery, low-level navigation, target location, bombing, and weapon delivery.
- Air corridors for friendly aircraft to transit through the battle area can be set with greater accuracy.

d. **Operations in Space.** The use of GPS to conduct satellite orbit location determination can enhance the satellite's autonomy and be vital in space force applications.

"Air Force F-16s used GPS to great advantage in navigating to initial points on bombing runs and then, at night, letting the LANTIRN (Low-Altitude Navigation and Targeting Infrared for Night) system take them the rest of the way. Navy pilots relied on GPS to put their planes in the right places to launch standoff land-attack missiles (SLAM). Once launched, those long-range SLAMs steered themselves by means of signals from GPS satellites . . . One SLAM would open a hole and the next SLAM would go through the hole and blow up the target. GPS was a big reason for their accuracy."

Air Force Magazine, August 1991, p. 35

3. Advantages

a. **Accuracy.** The GPS constellation provides continuous global service. The type of receiver used and the number and geometric configuration of the satellites in view determine accuracy.

b. **Accessibility.** Because GPS equipment is **passive**, it is capable of providing continuous real-time information. Any authorized user with a keyed PPS receiver has access to the most precise position, velocity, time, and navigation information. However, commercial user equipment cannot receive and process the PPS information and is limited to the SPS signal.

c. **Graceful Degradation.** Because of the number and orbit location of satellites in the GPS constellation, a single satellite failure will not cause significant degradation of the system.

d. **Common Grid.** The default navigation grid used by the GPS is the World Geodetic System 1984 (WGS-84). WGS-84 can be easily converted to any grid reference using the terminal device.

e. **Space based navigation systems (e.g., GPS) are resistant to some types of jamming.** The use of nulling antennas/filters, and the correct placement of GPS receivers on various platforms all improve jamming resistance. Tactical measures (such as placing a hand-held receiver at the bottom of a foxhole to reduce the effects from ground based jammers) also help.

f. **Anti-Spoofing (A/S).** With the precise capability provided by the GPS, a logical concern is that an adversary could generate **false signals** to mislead an authorized user with respect to its position or time. A/S mitigates receiver confusion that might be caused by intentionally misleading, hostile transmissions.

4. Limitations

Limitations generally fall into four categories. First, adversary exploitation of the SPS causes the US military advantage to be somewhat reduced. Currently, to prevent the adversary from using the SPS data requires resources and time that can be more effectively used elsewhere. Secondly, the civil and commercial use of the SPS has also imposed constraints on the military's altering the GPS signal in space. Because of the tremendous civil dependence on the system, the Department of Defense is now limited in what it can do with the signal based on the possibility of causing severe disruption to commercial operations. US law and policy direct the Department of Defense to develop a means of preventing hostile use of GPS in a particular area without hindering peaceful civil use of the system elsewhere. Third, jamming GPS can adversely affect not only civil operations, but joint military operations within a geographic area. The stronger the jammer, the larger the effected area. Combatant commanders and their subordinate JFCs must factor potential GPS jamming into their electronic warfare plan. Because combatant commanders and subordinate JFCs may need to eliminate or counter adversary jammers, more robust protection and prevention measures will be required in the future. Consideration must also be given to friendly interference, which is coordinate via the Joint Restricted Frequency List. Coordination procedures for this list are detailed in JP 3-51, *Joint Doctrine for Electronic Warfare*. Fourth, the

GPS relies on users receiving signals from at least four satellites simultaneously for a three dimensional position and navigation data (only one signal is needed for timing). Units relying on hand-held GPS receivers in areas of dense vegetation or steep terrain may have diminished GPS capabilities.

GPS navigation signals are affected by ionospheric scintillation. Scintillation occurs more often in the mid-latitudes (40-60 degrees latitude (North or South)). It can occur anywhere over the globe but is worse in the Eastern Atlantic, North Africa, and Southwest Asia regions. The effects will be greater in the hemisphere (Northern or Southern) of the planet that is experiencing the summer season. Scintillation is a local effect that has daily and seasonal variations. The effects are worse at local sunset and will usually taper off by local midnight. GPS position solutions will be affected in varying degrees and may be quite erratic at times. There is no good mitigation technique for scintillation—it must be waited out.

5. Support Procedures

System Operations. A JFC's operational influence on the GPS is limited. A JFC can request a **change in SA implementation**, thereby changing the degree of accuracy of the signal. However, due to the global nature of SA, any change in its configuration would affect SPS users on a worldwide basis with significant political ramifications. A JFC that requires such changes would address the requirement to the Chairman of the Joint Chiefs of Staff through the NMCC, with an informational copy to USSPACECOM. Commander, USSPACECOM initiates an impact assessment and forwards a recommendation to the Chairman of the Joint Chiefs of Staff. If approved by the Chairman, the Commander, USSPACECOM directs execution of requested performance changes (see Figure E-2).

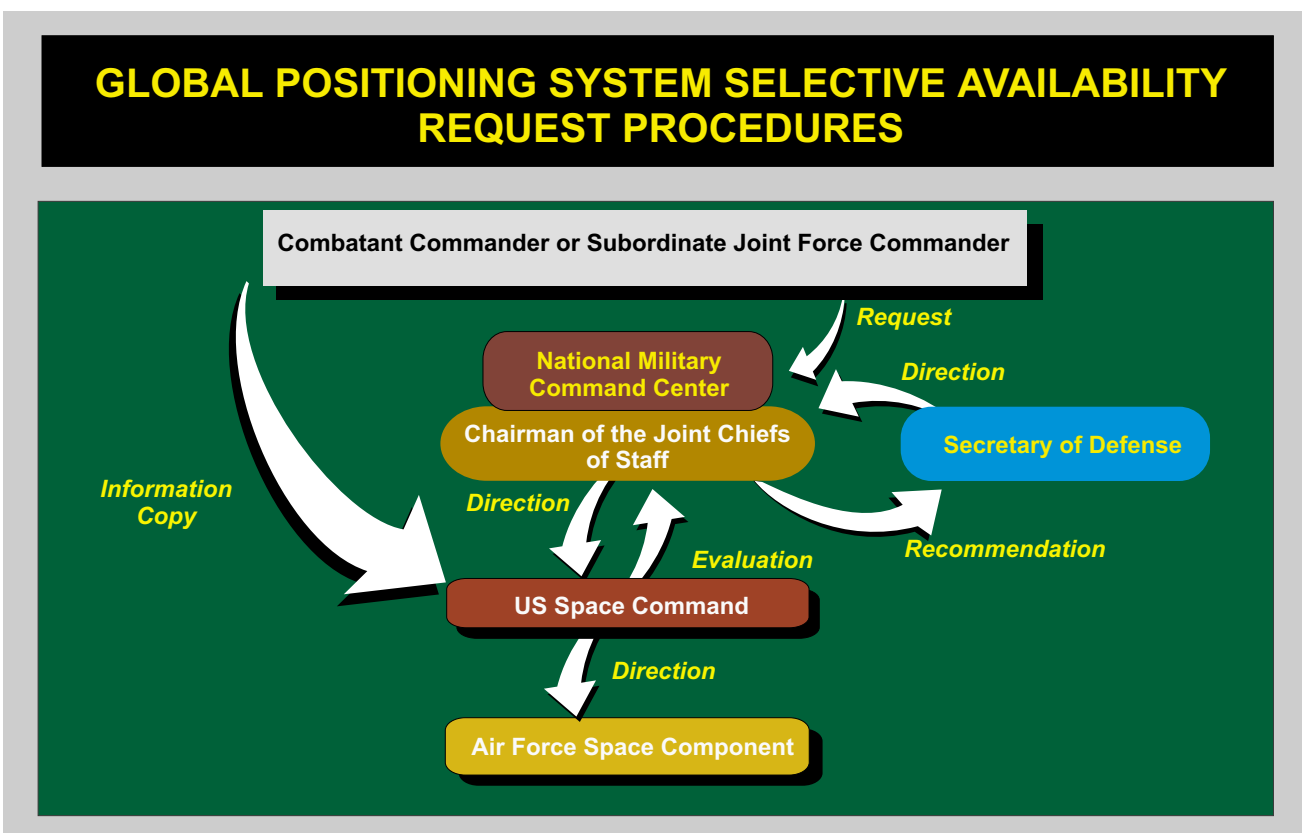


Figure E-2. Global Positioning System Selective Availability Request Procedures

APPENDIX F

ORBITAL CHARACTERISTICS

1. Operational Advantages of Space

Because the constellation design and orbital characteristics of a space system can vary greatly, the different system strengths and limitations must be considered when planning any space mission. In general, space systems provide the ultimate high ground without any overflight restrictions. The absence of significant drag and other natural opposing forces also allows space systems to have increased longevity, sometimes limited only by the reliability of the systems themselves (see Figure F-1). However, there are several forces at work that slowly degrade the prediction accuracy of a satellite's location, including: atmospheric drag (air particles and atoms exist even at very high altitudes); gravitational attractions of the Sun, Moon, and other planets; the fact that the Earth is not a perfect sphere and the force of gravity varies; gentle pressure from solar radiation; and the interaction of solar radiation and the Earth's geomagnetic environment.

2. A Satellite Period of Orbit

The size of a satellite's orbit determines its period, or the time it takes to complete one revolution. The lower the orbital altitude, the shorter the period. Common orbits have periods ranging from about 90 minutes (low orbits just above the atmosphere) to 24 hours ("geosynchronous" orbits 22,300 statute miles above the Earth's surface) (see Figure F-2). ("Eccentricity" is a term used to describe how much an orbit's shape deviates from a circle. The figure ranges from 0-1 with a value of 0 for a circular orbit. The eccentricity is computed as the difference between the maximum and minimum altitudes of the orbit, divided by twice the size of the orbit.)

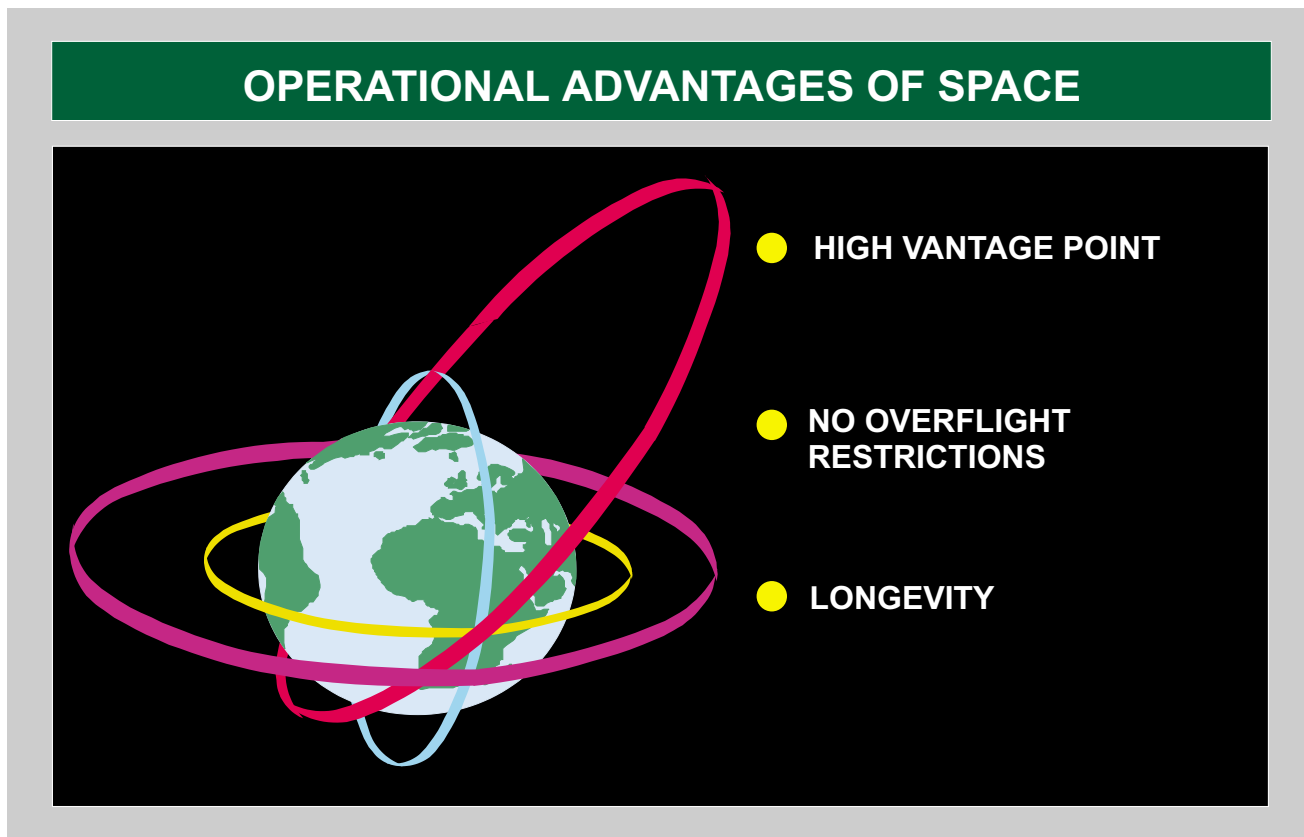


Figure F-1. Operational Advantages of Space

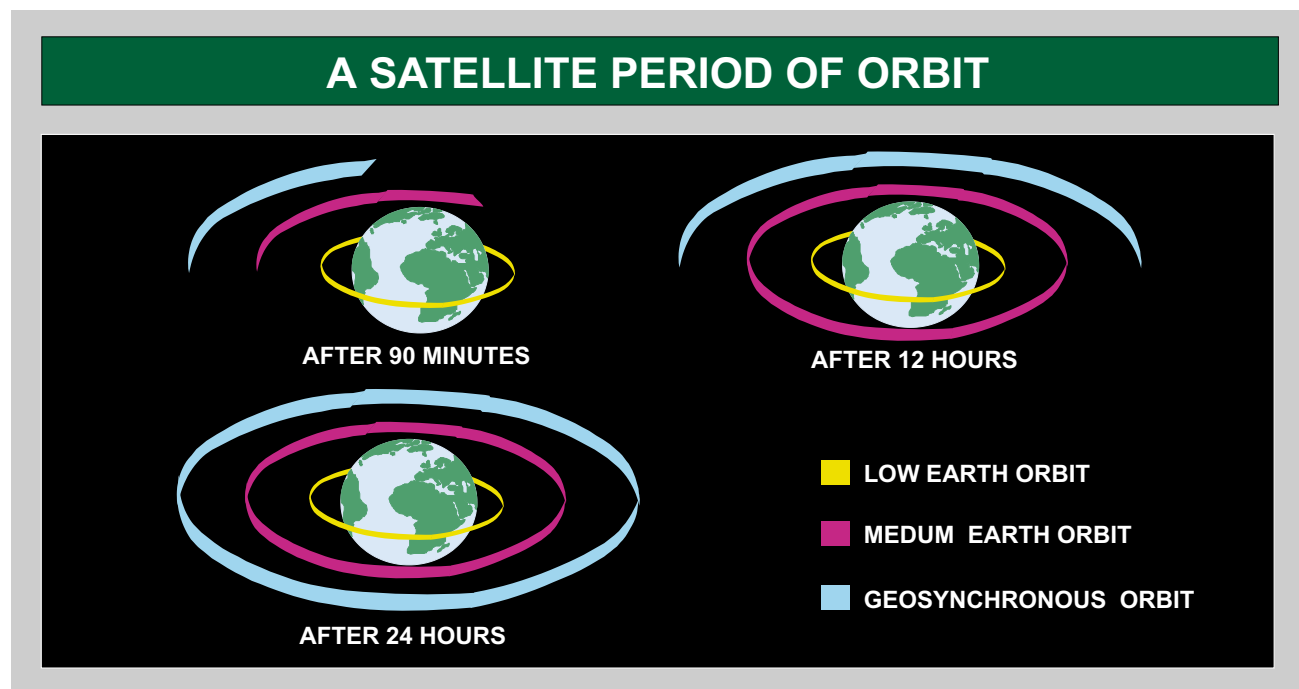


Figure F-2. A Satellite Period of Orbit

3. Inclination

A satellite's inclination is the angle between the Earth's equatorial plane and the satellite's orbital plane (measured counterclockwise from the equatorial to the orbital plane at the point where the satellite's path crosses the equator headed northward) (see Figure F-3). This angle determines what part of the Earth's surface passes directly beneath the satellite — a critical consideration in accomplishing its mission (see Figure F-4). Depending on the inclination, a single satellite may not be able to provide coverage of a specific point on or region of the Earth. However, a constellation may have that capability. Other space systems — civil, commercial, international, and military — may be used to supplement the satellite's capability and provide continuous, non-intrusive coverage.

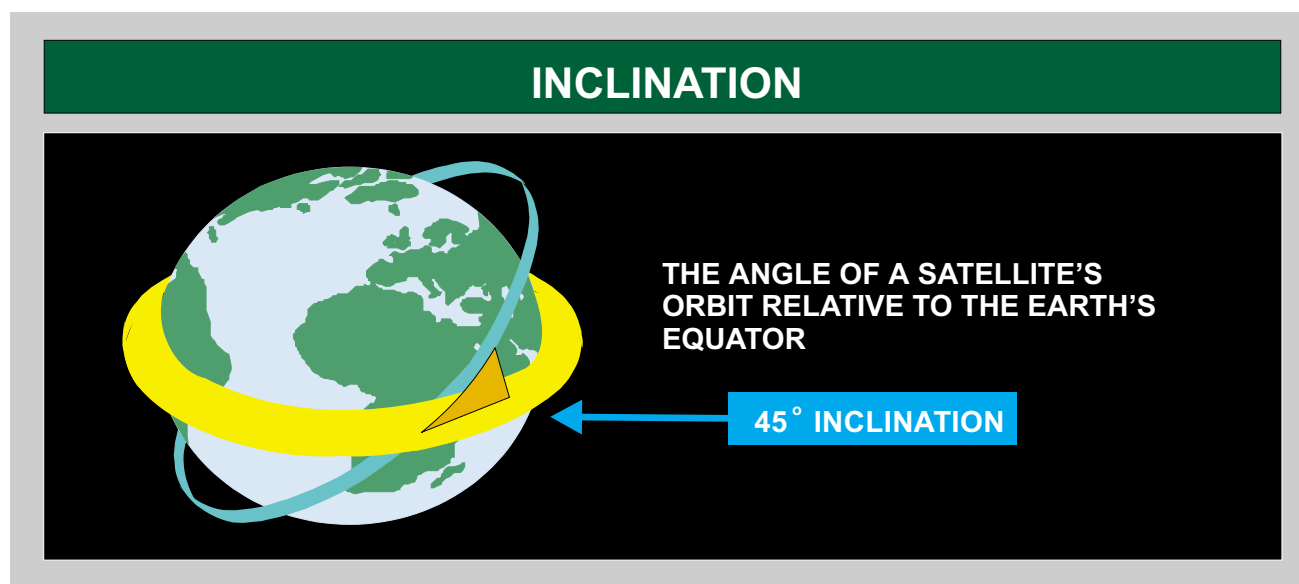


Figure F-3. Inclination

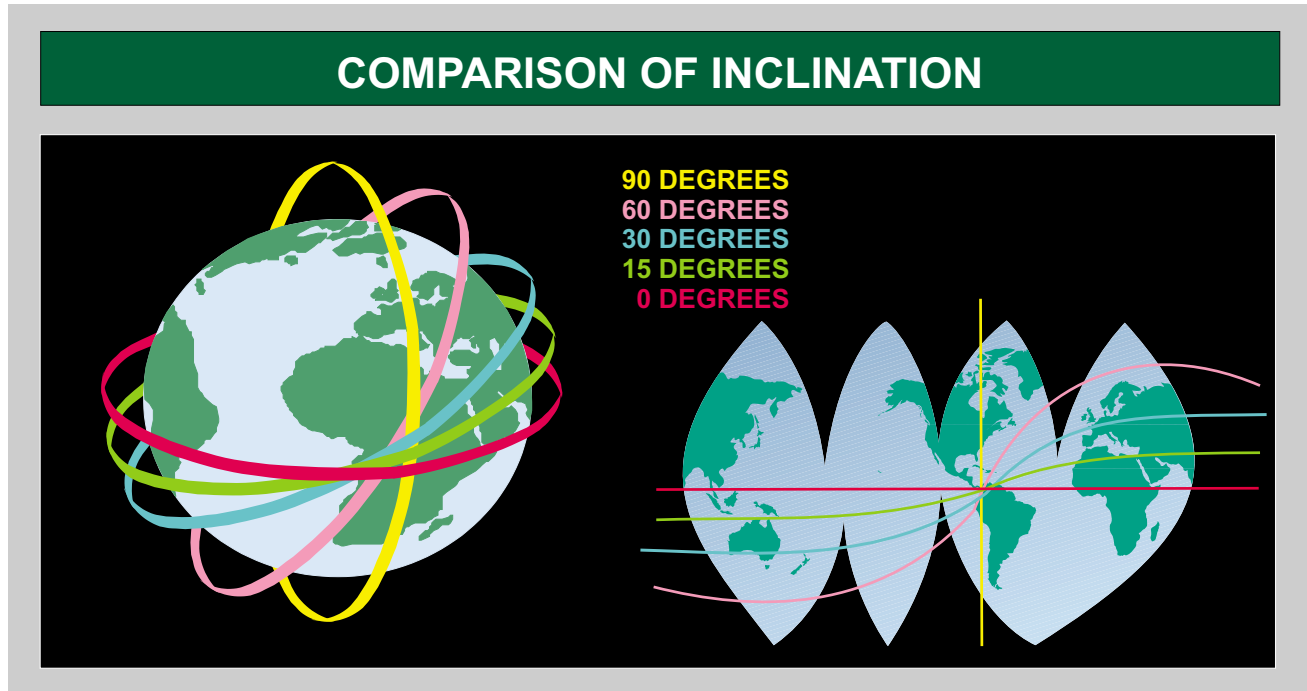


Figure F-4. Comparison of Inclination

4. Types of Orbits

See Figure F-5.

a. **Low Earth Orbit (LEO).** LEO is the easiest type of orbit to reach, and the object's proximity to the surface provides the best potential for high-resolution imagery (see Figure F-6). However, objects in these orbits have relatively smaller fields of view than those at higher altitudes, and atmospheric drag can shorten mission duration. LEO applications include manned flight, reconnaissance, and communications missions.

b. **Polar Orbits.** Strictly speaking, polar orbits (typically a type of LEO) have an inclination of 90 degrees and fly over the poles, thus providing coverage of the entire Earth (see Figure F-7). A type of orbit that is approximately polar and frequently used synonymously (but incorrectly) with "polar" is a "sun synchronous" orbit. A sun synchronous orbit maintains a constant orientation towards the sun during a year. In order to do this, the inclination must be greater than 90 degrees (typically 90-120,

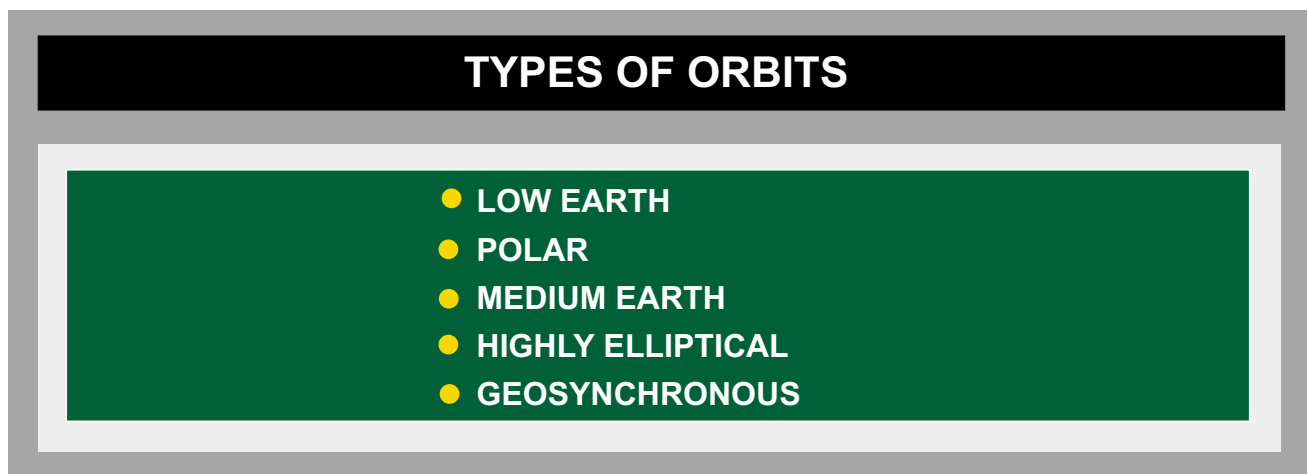


Figure F-5. Types of Orbits

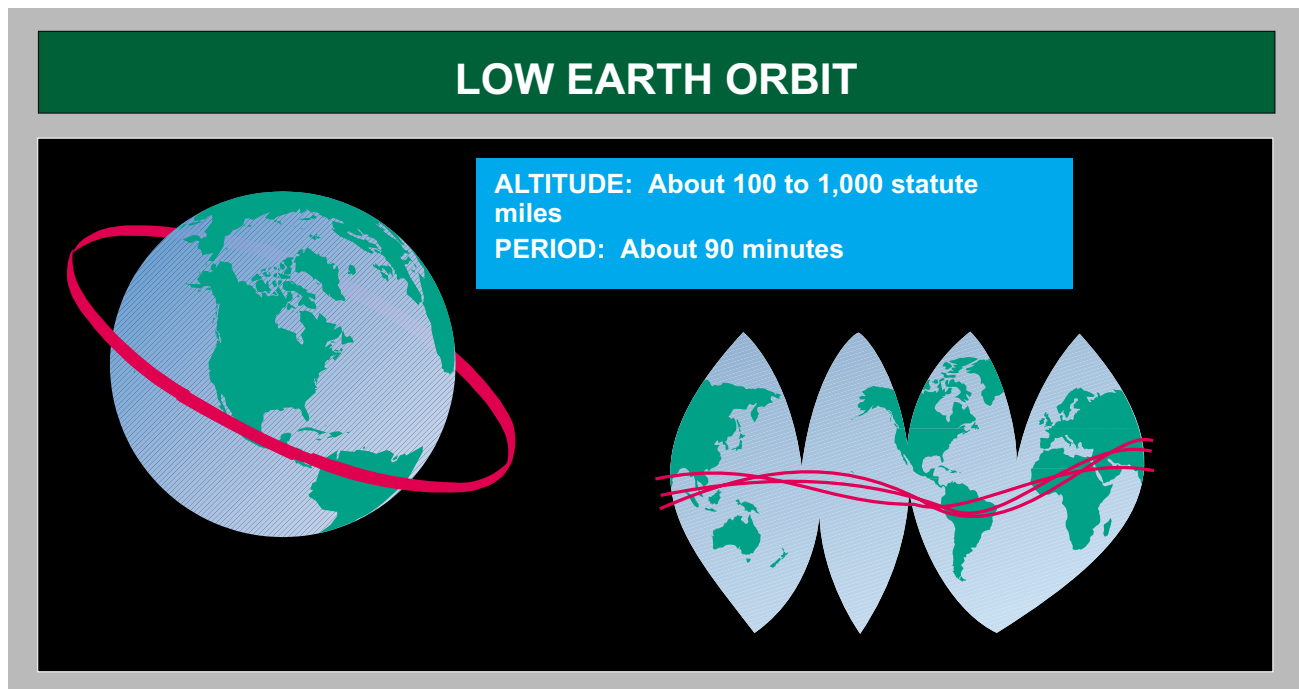


Figure F-6. Low Earth Orbit

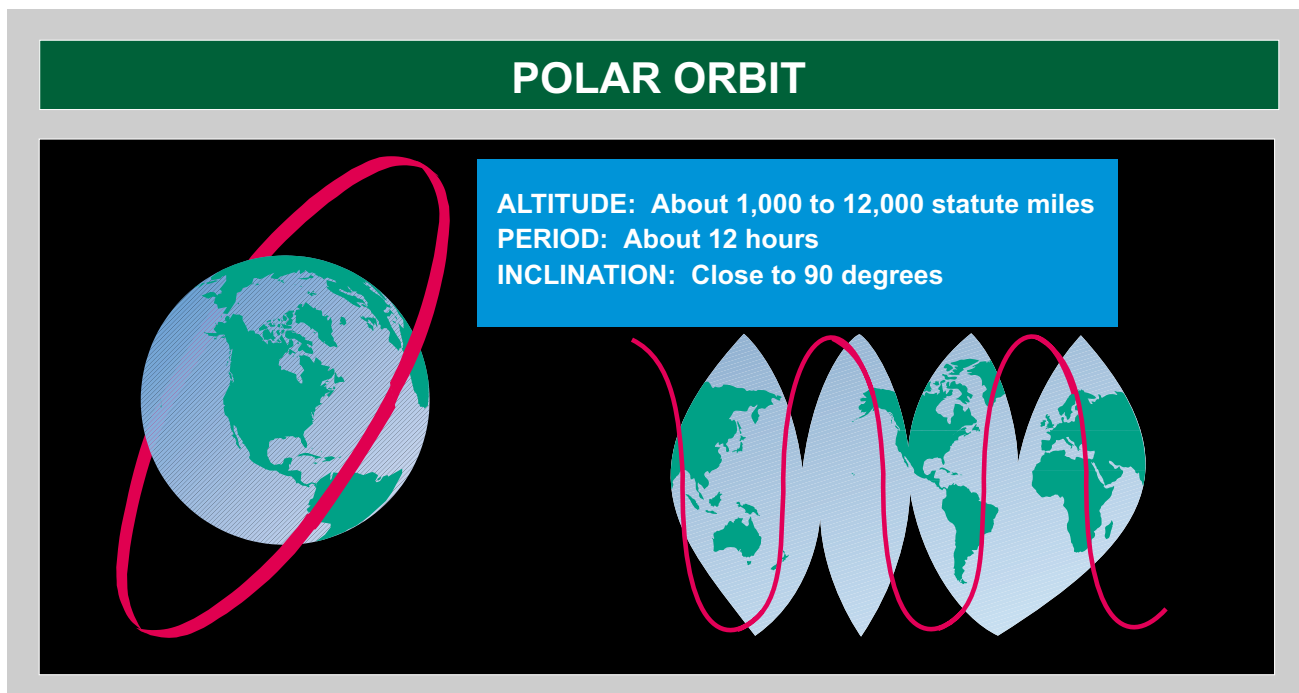


Figure F-7. Polar Orbit

depending on altitude and shape of orbit). This type of orbit is useful for various reasons — for example maintaining a constant viewing condition when observing the Earth (e.g. shadows, etc.). Applications include weather, Earth resources, and reconnaissance in the visible light portion of the spectrum. Sun-synchronous orbits are applied to achieve global coverage from low altitude in minimal time, offering repetitive viewing of the same geographic locations at the same sun-angle. For example, detection of troop movements can be accomplished through image and shadow changes.

c. **Medium Earth Orbit (MEO).** MEO provides a larger field of view and a longer dwell time than LEO. While atmospheric drag is negligible, a lot more energy is required to place a satellite in these orbits (see Figure F-8). Current applications include navigation systems (e.g., GPS).

d. **Highly Elliptical Orbit (HEO).** HEO also provides large fields of view. For example, HEO can furnish long dwell times over the Northern Hemisphere when in a highly inclined orbit with apogee (the point farthest from the Earth's surface) over the Northern Hemisphere, including the polar regions (areas not adequately viewed by geosynchronous Earth orbit satellites that are stationed over the equator) (see Figure F-9). Another term used for HEOs is "Molniya" (the Russian word for 'lightning' and a constellation of Russian communication satellites in HEO). True Molniya orbits are inclined at approximately 63.4 degrees, with perigee (the point in the orbit closest to the Earth) at the southernmost point of the orbit, and have a period of approximately 12 hours. They have long dwell times over the Northern Hemisphere while traveling quickly past the Southern Hemisphere. Applications include communications, scientific missions, and ISR.

e. **Geosynchronous Earth Orbit (GEO).** GEO satellites have periods exactly equal to the Earth's rotation (24 hours) (see Figure F-10). Orbits of any inclination can be geosynchronous. Geostationary satellites remain over one spot on the Earth at all times. In order to do this, they must not only be geosynchronous, but also equatorial (zero inclination) and circular (zero eccentricity). This particular type of orbit is known as Geo-synchronous Equatorial Orbit. Thus, all geostationary satellites are geosynchronous, but not all geosynchronous satellites are geostationary. The ground trace of GEO satellites in circular orbits with non-zero inclination describe a figure "8", spending equal time over the northern and southern hemispheres. Geosynchronous orbits have an altitude of approximately 23,000 statute miles, are difficult to reach, and require launch vehicles with significant energy to lift satellites to these orbits. Geosynchronous satellites provide wide fields of view with continuous coverage of the portions of the Earth they orbit. Therefore they are very useful for communications, weather, and ISR.

5. Constellations

a. When a single satellite cannot provide the coverage necessary to accomplish a given mission, multiple satellites performing a single mission (a constellation) are used to provide global coverage or increase timeliness of coverage (see Figure F-11 and Figure F-12). Navigation constellations (such as GPS) are designed to ensure that signals from multiple satellites can be simultaneously received at a location on the ground, improving the accuracy of the information coming from those satellites.

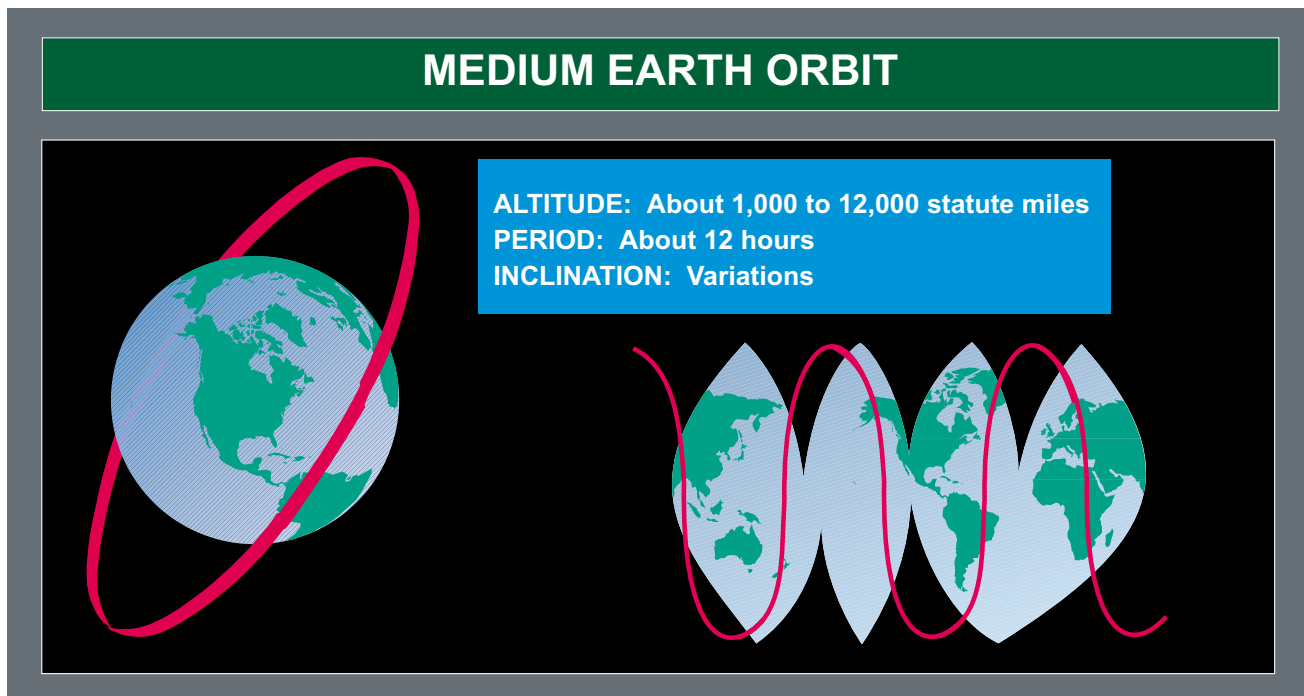


Figure F-8. Medium Earth Orbit

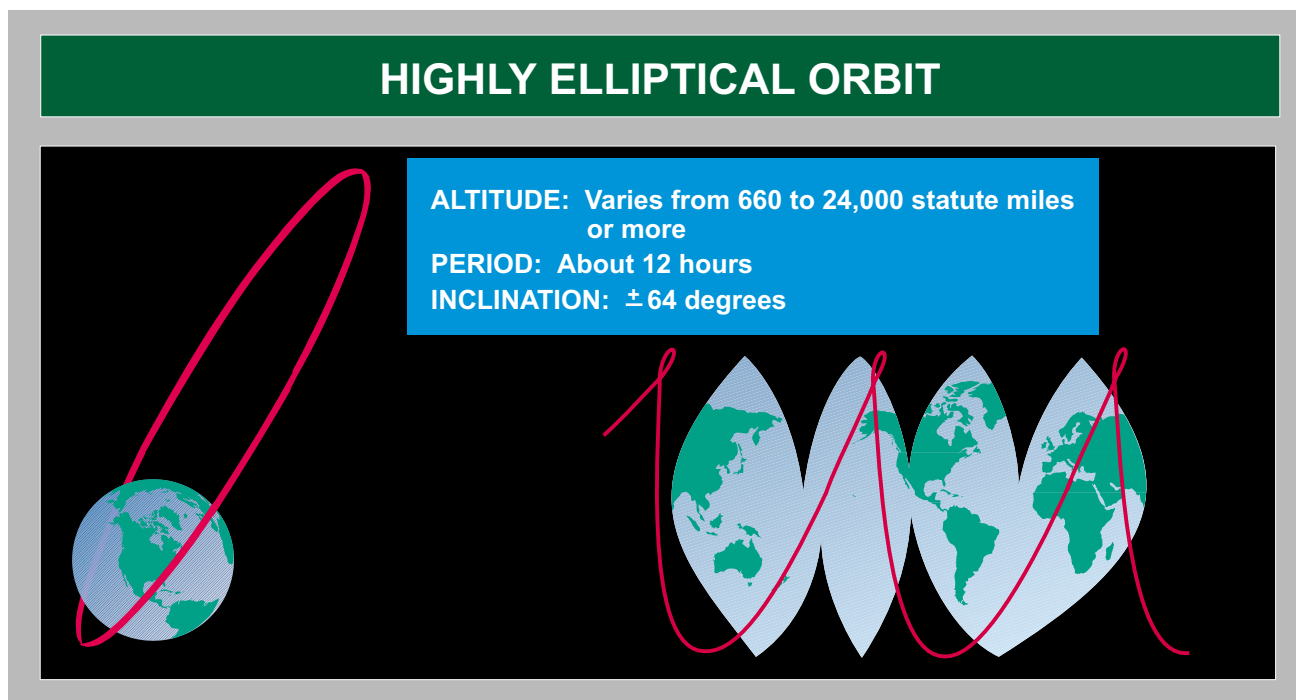


Figure F-9. Highly Elliptical Orbit

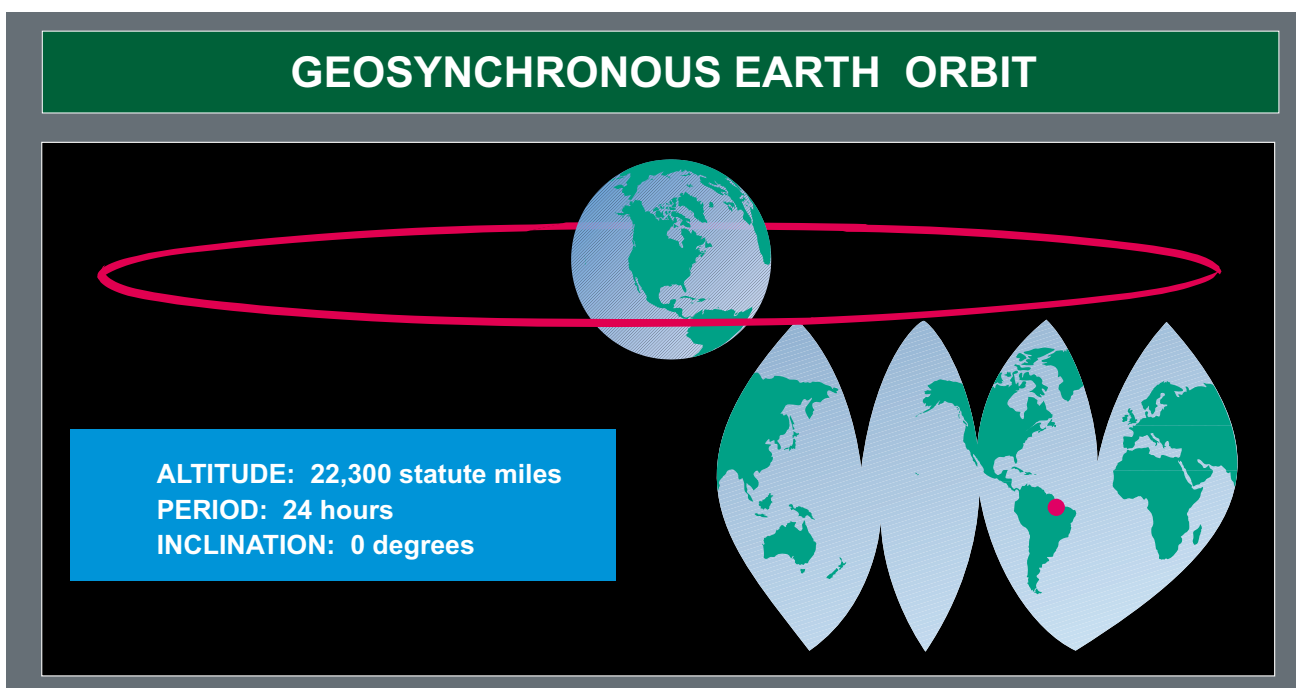


Figure F-10. Geosynchronous Earth Orbit

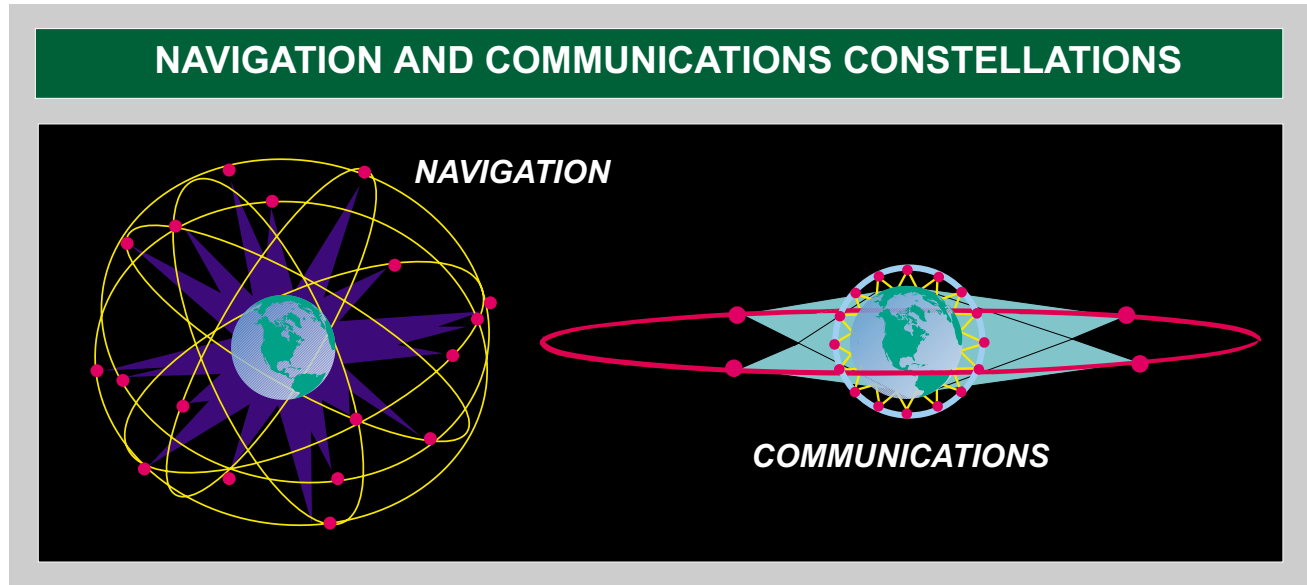


Figure F-11. Navigation and Communications Constellations

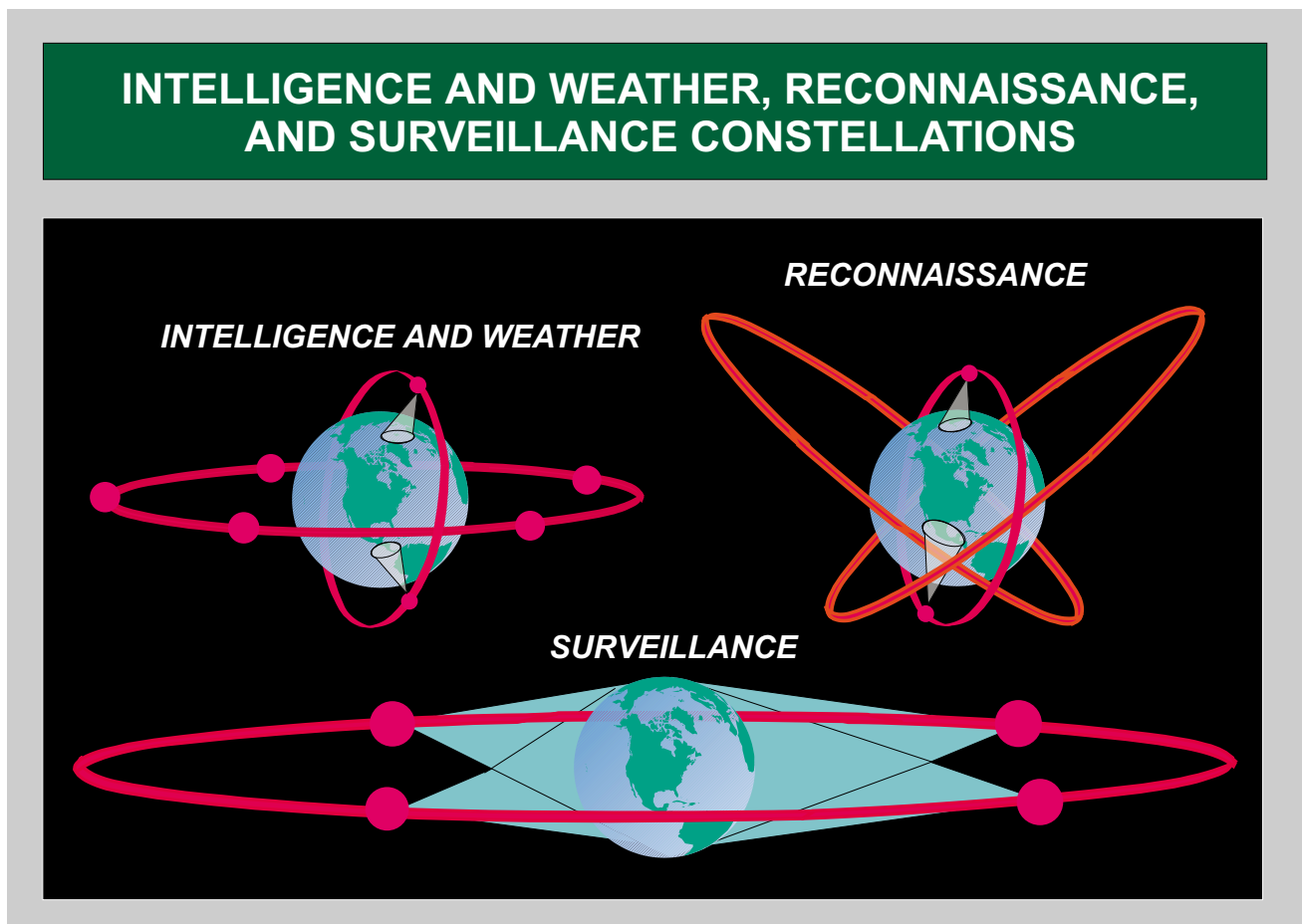


Figure F-12. Intelligence and Weather, Reconnaissance, and Surveillance Constellations

Communications constellations, on the other hand, are designed to ensure that at least one satellite is within LOS of both ends of the communications link, and may include both equatorial and polar components.

b. Weather and reconnaissance systems may require constellations that combine high and low altitude systems. This provides on-board sensors with the capability to acquire wide-area, low-resolution coverage and limited field of view, high-resolution coverage, respectively. Some ISR systems, on the other hand, need continuous access to the areas surveyed and usually rely on high altitude, long dwell time orbits.

APPENDIX G

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APPENDIX H

ADMINISTRATIVE INSTRUCTIONS

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Users in the field are highly encouraged to submit comments on this publication to: Commander, United States Joint Forces Command, Joint Warfighting Center Code JW100, 116 Lake View Parkway, Suffolk, VA 23435-2697. These comments should address content (accuracy, usefulness, consistency, and organization), writing, and appearance.

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- b. When a Joint Staff directorate submits a proposal to the Chairman of the Joint Chiefs of Staff that would change source document information reflected in this publication, that directorate will include a proposed change to this publication as an enclosure to its proposal. The Military Services and other organizations are requested to notify the Director, J-7, Joint Staff, when changes to source documents reflected in this publication are initiated.

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GLOSSARY

PART I — ABBREVIATIONS AND ACRONYMS

AJ	anti-jam
AOC	aerospace operations center
AOI	area of interest
AOR	area of responsibility
ARSPACE	Army Space Command
A/S	anti-spoofing
ASD(C3I)	Assistant Secretary of Defense (Command, Control, Communications, and Intelligence)
BDA	battle damage assessment
C2	command and control
C/A	course acquisition
CCC	Combined Command Center (USSPACECOM)
CIA	Central Intelligence Agency
CIC	Combined Intelligence Center
CJCS	Chairman of the Joint Chiefs of Staff
CJCSI	Chairman of the Joint Chiefs of Staff instruction
CJCSM	Chairman of the Joint Chiefs of Staff manual
CMOC	Cheyenne Mountain Operations Center
COA	course of action
COCOM	combatant command (command authority)
COG	center of gravity
CONPLAN	operation plan in concept format
DIA	Defense Intelligence Agency
DISA	Defense Information Systems Agency
DOD	Department of Defense
EAP	Emergency Action Procedures
EHF	extremely high frequency
FDO	flexible deterrent option
FNMOCC	Fleet Numerical Meteorology and Oceanography Center
GBS	Global Broadcast Service
GEO	geosynchronous Earth orbit
GI&S	geospatial information and services
GPS	global positioning system
HEO	highly elliptical orbit
HN	host nation
IPB	intelligence preparation of the battlespace
ISR	intelligence, surveillance, and reconnaissance
ITU	International Telecommunications Union
ITW/AA	integrated tactical warning and attack assessment
J-2	intelligence directorate of a joint staff
J-3	operations directorate of a joint staff
J-4	logistics directorate of a joint staff

J-6	command, control, communications, and computer systems directorate of a joint staff
JFC	joint force commander
JIPB	joint intelligence preparation of the battlespace
JOA	joint operations area
JP	joint publication
JSPA	joint satellite communications (SATCOM) panel administrator
JSST	joint space support team
JTAGS	joint tactical ground station (Army and Navy)
JTF	joint task force
LEO	low Earth orbit
LNO	liaison officer
LOS	line of sight
LPD	low probability of detection
LPI	low probability of intercept
MEO	medium Earth orbit
METOC	meteorological and oceanographic
MILSATCOM	military satellite communications
MSI	multi-spectral imagery
NAVSPACECOM	Naval Space Command
NAVSPOC	Naval Space Operations Center
NIMA	National Imagery and Mapping Agency
NIST	national intelligence support team
NMCC	National Military Command Center
NOAA	National Oceanic and Atmospheric Administration
NORAD	North American Aerospace Defense Command
NRO	National Reconnaissance Office
NSA	National Security Agency
NUDET	nuclear detonation
OPCON	operational control
OPLAN	operation plan
OPORD	operation order
PPS	precise positioning service
R&D	research and development
SA	selective availability (GPS)
SATCOM	satellite communications
SDB	Satellite Communications Database
SecDef	Secretary of Defense
SEW	shared early warning
SHF	super-high frequency
SOM	system operational manager
SPACEAF	Space Air Forces
SPOC	USSPACECOM Operations Center
SPS	standard positioning service
SSE	satellite communications (SATCOM) systems expert
SST	space support team

TACON	tactical control
TBMD	theater ballistic missile defense
TENCAP	tactical exploitation of national capabilities
TES	theater event system
TT&C	telemetry, tracking, and commanding
UHF	ultra high frequency
USAF	United States Air Force
USELECMOC	United States Element Cheyenne Mountain Operations Center
USG	United States Government
USSPACECOM	United States Space Command
WGS-84	World Geodetic System 1984

PART II — TERMS AND DEFINITIONS

area of responsibility. The geographical area associated with a combatant command within which a combatant commander has authority to plan and conduct operations. Also called AOR. (JP 1-02)

attack assessment. An evaluation of information to determine the potential or actual nature and objectives of an attack for the purpose of providing information for timely decisions. (JP 1-02)

battlespace. The environment, factors, and conditions that must be understood to successfully apply combat power, protect the force, or complete the mission. This includes the air, land, sea, space, and the included enemy and friendly forces; facilities; weather; terrain; the electromagnetic spectrum; and the information environment within the operational areas and areas of interest. (JP 1-02)

combatant command. A unified or specified command with a broad continuing mission under a single commander established and so designated by the President, through the Secretary of Defense and with the advice and assistance of the Chairman of the Joint Chiefs of Staff. Combatant commands typically have geographic or functional responsibilities. (JP 1-02)

combatant command (command authority). Nontransferable command authority established by title 10 (“Armed Forces”), United States Code, section 164, exercised only by commanders of unified or specified combatant commands unless otherwise directed by the President or the Secretary of Defense. Combatant command (command authority) cannot be delegated and is the authority of a combatant commander to perform those functions of command over assigned forces involving organizing and employing commands and forces, assigning tasks, designating objectives, and giving authoritative direction over all aspects of military operations, joint training, and logistics necessary to accomplish the missions assigned to the command. Combatant command (command authority) should be exercised through the commanders of subordinate organizations. Normally this authority is exercised through subordinate joint force commanders and Service and/or functional component commanders. Combatant command (command authority) provides full authority to organize and employ commands and forces as the combatant commander considers necessary to accomplish assigned missions. Operational control is inherent in combatant command (command authority). Also called COCOM. (JP 1-02)

constellation. A number of like satellites that are part of a system. Satellites in a constellation generally have a similar orbit. For example, the Global Positioning System constellation consists of 24 satellites distributed in six orbital planes with similar eccentricities, altitude, and inclination. (Approved for inclusion in the next edition of JP 1-02.)

coordinating authority. A commander or individual assigned responsibility for coordinating specific functions or activities involving forces of two or more Military Departments, two or more joint force components, or two or more forces of the same Service. The commander or individual has the authority to require consultation between the agencies involved, but does not have the authority to compel agreement. In the event that essential agreement cannot be obtained, the matter shall be referred to the appointing authority. Coordinating authority is a consultation relationship, not an authority through which command may be exercised. Coordinating authority is more applicable to planning and similar activities than to operations. (JP 1-02)

deception. Those measures designed to mislead the enemy by manipulation, distortion, or falsification of evidence to induce the enemy to react in a manner prejudicial to the enemy’s interests. (JP 1-02)

geospatial information and services. The concept for collection, information extraction, storage, dissemination, and exploitation of geodetic, geomagnetic, imagery (both commercial and national source), gravimetric, aeronautical, topographic, hydrographic, littoral, cultural, and toponymic data accurately referenced to a precise location on the earth’s surface. These data are used for military planning, training, and operations including navigation, mission planning, mission rehearsal, modeling, simulation and precise targeting. Geospatial information provides the basic framework for battlespace visualization. It is information produced by multiple sources to common interoperable data standards. It may be presented in the form of printed maps, charts, and publications; in digital simulation and modeling databases; in photographic form; or in the form of digitized maps and charts or attributed centerline data. Geospatial services includes tools that enable users to access and manipulate data, and also includes instruction, training, laboratory support, and guidance for the use of geospatial data. Also called GI&S. (JP 1-02)

joint force commander. A general term applied to a combatant commander, subunified commander, or joint task force commander authorized to exercise combatant command (command authority) or operational control over a joint force. Also called JFC. See also joint force. (JP 1-02)

link element. The means (electromagnetic energy) used to convey data and information between the space element and the terrestrial element of a space system. (Approved for inclusion in the next edition of JP 1-02.)

multi-spectral imagery. The image of an object obtained simultaneously in a number of discrete spectral bands. Also called MSI. (JP 1-02)

negation. Measures to deceive, disrupt, deny, degrade, or destroy an adversary's space systems and services or any other space system or service used by an adversary that is hostile to US national interests. See also space control. (Approved for inclusion in the next edition of JP 1-02.)

operational control. Command authority that may be exercised by commanders at any echelon at or below the level of combatant command. Operational control is inherent in combatant command (command authority) and may be delegated within the command. When forces are transferred between combatant commands, the command relationship the gaining commander will exercise (and the losing commander will relinquish) over these forces must be specified by the Secretary of Defense. Operational control is the authority to perform those functions of command over subordinate forces involving organizing and employing commands and forces, assigning tasks, designating objectives, and giving authoritative direction necessary to accomplish the mission. Operational control includes authoritative direction over all aspects of military operations and joint training necessary to accomplish missions assigned to the command. Operational control should be exercised through the commanders of subordinate organizations. Normally this authority is exercised through subordinate joint force commanders and Service and/or functional component commanders. Operational control normally provides full authority to organize commands and forces and to employ those forces as the commander in operational control considers necessary to accomplish assigned missions; it does not, in and of itself, include authoritative direction for logistics or matters of administration, discipline, internal organization, or unit training. Also called OPCON. (JP 1-02)

prevention. 1. The security procedures undertaken by the public and private sectors in order to discourage terrorist acts. See also antiterrorism. 2. In space usage, measures to preclude an adversary's hostile use of United States or third-party space systems and services. Prevention can include diplomatic, economic, and political measures. See also space control. (This term and its definition modify the existing term and its definition and are approved for inclusion in the next edition of JP 1-02.)

protection. 1. Measures that are taken to keep nuclear, biological, and chemical hazards from having an adverse effect on personnel, equipment, or critical assets and facilities. Protection consists of five groups of activities: hardening of positions; protecting personnel; assuming mission-oriented protective posture; using physical defense measures; and reacting to attack. 2. In space usage, active and passive defensive measures to ensure that United States and friendly space systems perform as designed by seeking to overcome an adversary's attempts to negate them and to minimize damage if negation is attempted. See also space control. (This term and its definition modify the existing term and its definition and are approved for inclusion in the next edition of JP 1-02.)

reconnaissance. A mission undertaken to obtain, by visual observation or other detection methods, information about the activities and resources of an enemy or potential enemy, or to secure data concerning the meteorological, hydrographic, or geographic characteristics of a particular area. Also called RECON. (JP 1-02)

space. A medium like the land, sea, and air within which military activities shall be conducted to achieve US national security objectives. (Approved for inclusion in the next edition of JP 1-02.)

space asset. Any individual part of a space system as follows. (1) Equipment that is or can be placed in space (e.g., a satellite or a launch vehicle). (2) Terrestrially-based equipment that directly supports space activity (e.g., a satellite ground station). (Approved for inclusion in the next edition of JP 1-02.)

space capability. 1. The ability of a space asset to accomplish a mission. 2. The ability of a terrestrial-based asset to accomplish a mission in space (e.g., a ground-based or airborne laser capable of negating a satellite). (Approved for inclusion in the next edition of JP 1-02.)

space control. Combat, combat support, and combat service support operations to ensure freedom of action in space for the United States and its allies and, when directed, deny an adversary freedom of action in space. The space control mission area includes: surveillance of space; protection of US and friendly space systems; prevention of an adversary's ability to use space systems and services for purposes hostile to US national security interests; negation of space systems and services used for purposes hostile to US national security interests; and directly supporting battle management, command, control, communications, and intelligence (This term and its definition modify the existing term "space control operations" and its definition and are approved for inclusion in the next edition of JP 1-02.)

space environment. The region beginning at the lower boundary of the Earth's ionosphere (approximately 50 km) and extending outward that contains solid particles (asteroids and meteoroids), energetic charged particles (ions, protons, electrons, etc.), and electromagnetic and ionizing radiation (x-rays, extreme ultraviolet, gamma rays, etc.). (JP 1-02)

space-faring nation. A nation with the ability to access space capabilities using their indigenous space systems. (Approved for inclusion in the next edition of JP 1-02.)

space force application. Combat operations in, through, and from space to influence the course and outcome of conflict. The space force application mission area includes ballistic missile defense and force projection. (Approved for inclusion in the next edition of JP 1-02.)

space force enhancement. Combat support operations to improve the effectiveness of military forces as well as support other intelligence, civil, and commercial users. The space force enhancement mission area includes: intelligence, surveillance, and reconnaissance; integrated tactical warning and attack assessment; command, control, and communications; position, velocity, time, and navigation; and environmental monitoring. (Approved for inclusion in the next edition of JP 1-02.)

space forces. The space and terrestrial systems, equipment, facilities, organizations, and personnel necessary to access, use and, if directed, control space for national security. (Approved for inclusion in the next edition of JP 1-02.)

space power. The total strength of a nation's capabilities to conduct and influence activities to, in, through, and from space to achieve its objectives. (Approved for inclusion in the next edition of JP 1-02.)

space sensor. An instrument or mechanical device mounted on a space platform or space vehicle for collecting information or detecting activity or conditions either in space or in a terrestrial medium. (Approved for inclusion in the next edition of JP 1-02.)

space superiority. The degree of dominance in space of one force over another that permits the conduct of operations by the former and its related land, sea, air, space, and special operations forces at a given time and place without prohibitive interference by the opposing force. (Approved for inclusion in the next edition of JP 1-02.)

space support. Combat service support operations to deploy and sustain military and intelligence systems in space. The space support mission area includes launching and deploying space vehicles, maintaining and sustaining spacecraft on-orbit, and deorbiting and recovering space vehicles, if required. (This term and its definition modify the existing term "space support operations" and are approved for inclusion in the next edition of JP 1-02.)

space support team. A team of space operations experts provided by the Commander, US Space Command (or one of the space component commands and augmented by national agencies, as required) upon request of a geographic combatant commander to assist the supported commander in integrating space power into the terrestrial campaign. Also called SST. (Approved for inclusion in the next edition of JP 1-02.)

space surveillance. The observation of space and of the activities occurring in space. This mission is normally accomplished with the aid of ground-based radars and electro-optical sensors. This term is separate and distinct from the intelligence collection mission conducted by space-based sensors which surveil terrestrial activity. See also space control. (Upon approval of this publication, this term and its definition will be included in JP 1-02.)

space systems. All of the devices and organizations forming the space network. These consist of: spacecraft; mission packages(s); ground stations; data links among spacecraft, mission or user terminals, which may include initial reception, processing, and exploitation; launch systems; and directly related supporting infrastructure, including space surveillance and battle management and/or command, control, communications and computers. (Upon approval of this publication, this term and its definition will modify the existing term and its definition and will be included in JP 1-02.)

space weather. The conditions and phenomena in space and specifically in the near-earth environment that may affect space assets or space operations. Space weather may impact spacecraft and ground-based systems. Space weather is influenced by phenomena such as solar flare activity, ionospheric variability, energetic particle events, and geophysical events. (Upon approval of this publication, this term and its definition will modify the existing term and its definition and will be included in JP 1-02.)

sun-synchronous orbit. An orbit in which the satellite's orbital plane is at a fixed orientation to the sun, i.e., the orbit precesses about the Earth at the same rate that the Earth orbits the sun. It has the characteristics of maintaining similar sun angles along its ground trace for all orbits, and typically has an inclination from 96 to 98 degrees, depending on the orbit altitude and orbit shape (eccentricity). (Upon approval of this publication, this term and its definition will be included in JP 1-02.)

supported commander. 1. The commander having primary responsibility for all aspects of a task assigned by the Joint Strategic Capabilities Plan or other joint operation planning authority. In the context of joint operation planning, this term refers to the commander who prepares operation plans or operation orders in response to requirements of the Chairman of the Joint Chiefs of Staff. 2. In the context of a support command relationship, the commander who receives assistance from another commander's force or capabilities, and who is responsible for ensuring that the supporting commander understands the assistance required. (JP 1-02)

supporting commander. 1. A commander who provides augmentation forces or other support to a supported commander or who develops a supporting plan. Includes the designated combatant commands and Defense agencies as appropriate. 2. In the context of a support command relationship, the commander who aids, protects, complements, or sustains another commander's force, and who is responsible for providing the assistance required by the supported commander. (JP 1-02)

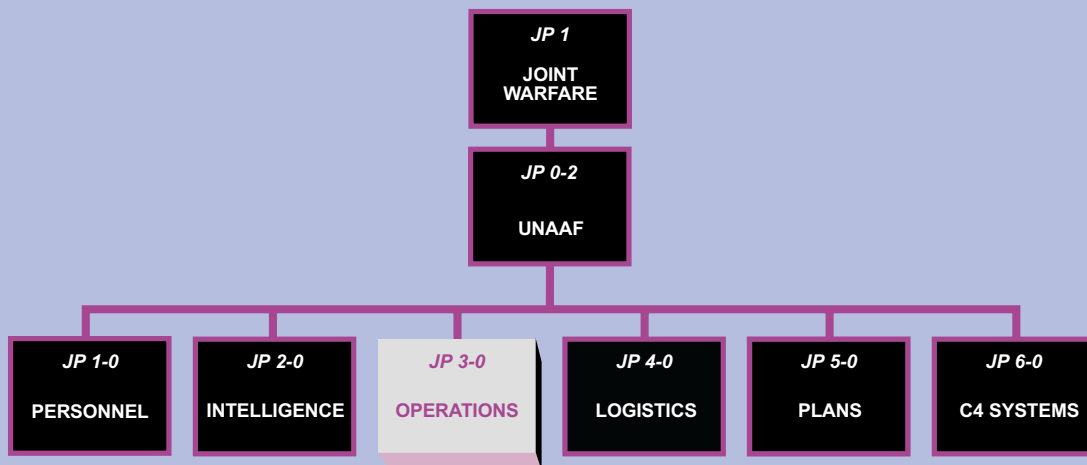
synchronous orbit. A satellite orbit where the orbital period is equal to, or multiples of, the Earth's rotational period; i.e. making one, two, three, etc., orbits in a 24-hour period. Examples include geosynchronous (period equals Earth's rotation), semisynchronous (two orbits per day); and geostationary (geosynchronous orbit where satellite maintains a fixed position on the equator). (Upon approval of this publication, this term and its definition will be included in JP 1-02.)

tactical control. Command authority over assigned or attached forces or commands, or military capability or forces made available for tasking, that is limited to the detailed direction and control of movements or maneuvers within the operational area necessary to accomplish missions or tasks assigned. Tactical control is inherent in operational control. Tactical control may be delegated to, and exercised at any level at or below the level of combatant command. When forces are transferred between combatant commands, the command relationship the gaining commander will exercise (and the losing commander will relinquish) over these forces must be specified by the Secretary of Defense. Tactical control provides sufficient authority for controlling and directing the application of force or tactical use of combat support assets within the assigned mission or task. Also called TACON. (JP 1-02)

terrestrial environment. The Earth's land area, including its manmade and natural surface and sub-surface features, and its interfaces and interactions with the atmosphere and the oceans. (JP 1-02)

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JOINT DOCTRINE PUBLICATIONS HIERARCHY



All joint doctrine and tactics, techniques, and procedures are organized into a comprehensive hierarchy as shown in the chart above. **Joint Publication (JP) 3-14** is in the Operations series of joint doctrine publications. The diagram below illustrates an overview of the development process:

